CROSSING AT THE SPEED OF CHANGE

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ABSTRACT

CROSSING AT THE SPEED OF CHANGE, by MAJ David R. Kelso, 104 pages.

Rivers have always posed a significant obstacle to attacking armies, with engineer elements proving vital to crossing them. As armies grew in size, both numerically and in terms of weight, multiple adaptations occurred, not least of which was the development of doctrine in support of combined arms breaching. Tracing the development of engineer methods and materiel from Caesar to World War II, this paper looks at the doctrinal support for hasty river crossings at the end of 1944. Based on analysis of the contemporary doctrine, the US Army had solid, suitable river crossing doctrine, which when applied properly led to successful hasty river crossings. Using a case study of the crossings of the Moselle River at Metz, Germany, both positive and negative effects of following, or failing to follow, doctrine are shown to support this finding. As the Army continues to refine doctrine it is important to remember the utility and applicability of doctrine, and the risks incurred when it is ignored.

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ACRONYMS

AD	Armored Division.
ADP	Army Doctrine Publication
ADRP	Army Doctrine Reference Publication
BG	Brigadier General
FM	Field Manual
HQ	Headquarters
ID	Infantry Division
LTG	Lieutenant General
MG	Major General

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CHAPTER 1

INTRODUCTION

The quintessential question in warfare never changes. Commanders endeavor to find an advantage over their adversary which shifts the odds in their favor. This may be sheer manpower or a combat multiplier such as technology. As warfare evolved from simple hand to hand combat to the modern form witnessed across the globe today, specialties emerged which proved vital to the successful execution of operations. Among these specialized groups, engineers stand out as one of the oldest and perhaps the most versatile. Engineer operations in war often occurred behind the scenes. An essential part in warfare since ancient times, the engineers contributed to mobility and counter-mobility of forces, performing these functions in both offensive and defensive operations. While the glory sought in medieval warfare laid with the combat arms, their efforts required support from engineers whose proximity to the front lines required at least proficiency with combat tactics as well. Most analysis of war and operations focuses on the specific effects of combat arms engaging and destroying the enemy, relegating the role of these vital support forces to vague generalized mobility or logistical train support terms. The impact of engineers on offensive operations at the tactical and operational level, essential to the successful execution of maneuver, remains a footnote in comparison. This paper looks to increase understanding of the tactical and operational effects of engineer mobility operations in war, in particular with regards to mobility across rivers.

Gap crossing operations were, and still are, complex. If at all possible, prior planning and rehearsals to synchronize the elements involved and enable smooth crossing is essential. However, if facing an enemy on the far shore, the complicated operation quickly becomes much more difficult and hazardous. Given the large number of moving pieces involved in a crossing, armies across the world developed doctrine to assist in the execution of this type of operation. This, in turn, provided the basis of training soldiers to accomplish their supporting roles. The US Army defines doctrine as the "fundamental principles, with supporting tactics, techniques, procedures . . . used for the conduct of operations."[1] It provides the collective knowledge of how to accomplish a given task, and ranges from conceptual approaches down to specific drills. Doctrine for conducting complex operations like river crossings is essential. The purpose of this paper is to add to the body of knowledge regarding US Army river crossing doctrine.

World War II, as one of the most well documented military campaigns, provides a unique opportunity to asses US Army river crossing doctrine. There are plenty of accounts to support investigation of doctrinal support for river crossings. Given the size and variety of terrain involved in the European Theater, as well as the need for quick operational adjustments common in World War II warfare, the tempo of operations was high, contributing to an emphasis on hasty operations. The high operational tempo constrained time spent on planning specific mission sets, which disproportionately affected complex operations such as river crossings. Therefore, the question is how well did army doctrine of World War II prepare units for hasty river crossings? As this paper demonstrates, the World War II river crossing doctrine was suitable for the time, and enabled success if it was followed. When units failed to effect a crossing, the result was

[1] Department of the Army, Army Doctrine Publication (ADP) 1-01, *Doctrine Primer* (Washington, DC: Government Printing Office, 2014), 1-02.

less indicative of doctrinal failures, and more of misapplication or misunderstanding of doctrine.

Any analysis such as this requires historical context. Engineers played a role in warfare since the beginning. Chapter 2 looks at the early approaches to the problem of crossing rivers. It examines what the engineers were integrated into the armies they served in and their missions. The early engineers, often referred to as Sappers, were used in ancient and medieval siege warfare. On the offense their role primarily consisted of various engineering works designed to enable maneuver forces to get close to, under or through fortresses without exposing themselves to significant defensive fire. As explosives were mastered, the engineers became experts at demolitions. Additionally, the engineer held responsibility to ensure capability for movement of the forces, bridging rivers and maintaining roads as required for operations. Defensively, the engineer was responsible for creation of defensive works. This duality of responsibility required engineer efforts at all times of warfare, increasing their visibility and impact, as well as their specialization. This section of study ends just prior to the American Civil War, where the introduction and use of expedient bridging in the form of ponton bridge equipment began to have a more prominent position.[2]

Chapter 3 looks at the changes which occurred in the Civil War timeframe, with regards to the organization, employment and equipment of engineers. As armies

[2] This study begins with a historical review of doctrine, which includes terms in common use by the engineers in the US Army, as well as foreign armies. While the more recognizable spelling of the boat, and bridge, type used in these operations is currently “pontoon,” the more accurate historical spelling is “ponton,” as seen in the 1915 Ponton Manual. For the sake of consistency, this term will be used throughout the paper, regardless of actual spelling at the specific point in time (quotes excepted).

increased in size, the movement of forces quickly degraded the condition and capacity of the road networks favored by military planners. The engineers became the primary agent for maintenance of these routes, along which the lines of communication and supplies that extended the operational reach of attacking armies. As artillery and other heavy machines of war increased in size bridge condition and capacity became a limiting factor for many routes, requiring either construction of new bridges, which took significant time, or finding an alternate route which may take more time, expose flanks, or increase logistical requirements. While an impediment to movement of the troops, the speed of armies generally did not require a rapid solution and proper prior planning sufficed to ensure the impact on an overall campaign remained minimal. However, when not properly planned, delays would occur.

These small changes initiated creation of new specialties within the engineer ranks. What began as a specialized demolition and construction force now encompassed topographers, horizontal construction, as well as bridge evaluation, maintenance, and construction. By the time World War I began, there were a multitude of engineer responsibilities. As the speed of armies increased, the importance of timely solutions to the issues engineers were responsible for required further specialization. With the advent of the combustion engine and use of vehicles in war, the speed of movement and maneuver drastically increased. This strained the capabilities of the engineer force.

World War II elevated the importance and complexity of engineer support with the increased use of heavier vehicles, particularly tanks. Chapter 4 focuses on how these large, heavy tools of war were significantly restricted by European terrain frequently broken up by rivers with old bridges insufficient to support the crossing of the new technology. Although tanks were used in World War I, the size and limited use of the vehicles lessened the importance of dedicated combat engineer units. Combat engineers supported maneuver through the European continent by conducting wet gap crossings, more commonly referred to as river crossings.

Although some limited doctrine development regarding mechanized river crossing occurred during the Interwar period, it focused on large scale, planned operations which required extensive planning and time to prepare.[3] The speed of World War II, with the surprise capability and relative speed of German tank warfare and the necessary Allied response to it, reduced the amount of time for planning with regards to even hasty river crossings. This required the staff to plan river crossings rapidly and adjust on the move to maintain initiative when an unexpected river crossing presented itself. In response, the US Army developed and published numerous new manuals in preparation for involvement in World War II. All services updated their versions of doctrine, and in some cases developed new doctrine, such as armor manuals. By the end of the war, the doctrine had been tested, updated, and tested again in the most unforgiving environments.

War may never change, but the ways in which it is waged certainly do. The US, while part of the victorious team from World War I and a few other smaller engagements in the Interwar period, was unsure of future performance on an armored and mechanized

[3] War Department, Engineer Field Manual, *Volume 1, Engineer Troops* (Washington, DC: Government Printing Office, 1932), 214. The approved doctrinal manuals printed during the Interwar period indicate no differentiation between hasty and deliberate crossings, instead emphasizing the recon and movement of assets in preparation for an assault over the river. While there was no specific mention of deliberate crossings, the criteria and language used to describe the operations matches that of a deliberate crossing in later manuals.

field. Despite significant training events, such as the Louisiana Maneuvers of 1941, initial performance was not fantastic. Failed crossings, such as the Rapido River in Italy, resulted in serious learning within the engineers and the combat arms. By the end of the war it appeared that the correct equipment and systems were in place. Chapter 5 looks at a case study involving Patton's Third Army and the assault on Fortress Metz, comparing the actions and orders of the units as they crossed the Moselle River. These units conducted two river crossings almost simultaneously, one a failure and the other a success. The difference between the two was adherence to doctrine, namely success followed when doctrinal models and concepts were used and failure occurred when directly contradicting the same.

Since the end of World War II the US has been involved in many conflicts. Ranging from the Korean War to Operation Desert Storm in Iraq, these various battles provided opportunities for engineers to demonstrate their capabilities. In the fight of the Global War on Terror, engineer officers focused on different, specialized areas of operations than the conventional fight. The requirements of operations in Iraq and Afghanistan necessitated using a separate skill set than the previous, Cold War mentality of force on force combat. Counter-insurgency (COIN) and stability operations provided a wide set of opportunities to contribute to the fight, but the core capabilities required for conventional war efforts degraded over time. As the United States Army begins transitioning from the COIN focus back to a more conventional, or a hybrid, war it is important to remember the challenges previous generations faced when confronted with a change in both training and operations. As Army doctrine undergoes format revisions, the usefulness of the documents must be verified, and if necessary updated. Chapter 6 comments on current and future doctrine and capabilities, with respect to similarities and differences from the World War II experience.

CHAPTER 2

A BRIEF INTRODUCTION TO RIVER CROSSING OPERATIONS

In the course of early warfare, naturally occurring obstacles such as rivers were considered the ultimate defense. Rivers consisted of constantly moving water in generally exposed conditions due to locations in a natural floodplain, or in difficult terrain which restricted maneuver such as ravines, both of which offered the defender significant advantages. While fording and boats made transit possible, the risks and resources required for mass movement of forces created logistical challenges. When swimming across the river no longer offered a feasible solution to crossing, armies devised a series of bridging options. As armies grew in size and aggression, new methods of crossing rivers required educated, or at least experienced, specialists to construct the means for bridging these obstacles. During the reign of the Roman Empire, relatively enduring bridges constructed of wood and stone were built to assure continued crossing capability.

Romans were renowned throughout the ancient world for their engineering prowess. They built complicated structures and durable roads, much of which exists still today. A military force unparalleled in their time, the Romans were highly expansionist. Their empire stretched throughout modern day Europe, and included a wide variety of terrain. Although the preeminent land force of the time, the army consisted of relatively simple composition. Centered on the infantry soldier, also known as the legionnaire, the Roman forces were often supplemented by a small cavalry force, some local tributary forces such as archers and foot soldiers, and a number of engineers and support personnel. Key to this composition, with respect to bridges, was the lack of large cumbersome weapons which required significant bridging assets. Although the cavalry and field trains included horses and other pack animals, for the most part the entire force was mobile under its own power and relatively light weight.[4] Thus, fording a river was still possible. However, projecting the perception of power using semi-permanent structures displaying their expertise and capability to could cross any obstacle at will was equally important. This was exemplified by the first recorded crossing of the Rhine River, as told in Caesar's Gallic War.

In 55 B.C. Caesar campaigned against the barbarian tribes in modern day Germany, defeating his adversaries, the Usipetes and the Tenecteri on the western side of the Rhine River. These tribes described being driven from Germania by a larger, more militant tribe, the Suebi, on the eastern side of the Rhine, who had no equal on Earth. Caesar clearly needed to send a message to the Germanic tribes that Rome alone stood invincible. So prove to the Suebi that Rome could cross at any point along the Rhine, Caesar spent ten days constructing a bridge out of timber, complete with protective works upstream.[5] Details of the bridge were found in Caesar's personal record of his campaign, indicating the size and complexity of the bridge itself. Requiring a large quantity of timber, suitable in size to accomplish the task, the Roman engineers designed a structure that actually enhanced in stability when the current of the river increased. The location, near modern day Koblenz, required a bridge of over 400 yards, with the river anywhere between 10-30 feet deep. Built of wood, the bridge's design would have been suitable as

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[4] Julius Caesar, *The Gallic War*, trans. H. J. Edwards (Cambridge, MA: Harvard University Press, 1917), Appendix A.

[5] Ibid., 201.

a permanent structure.[6] While astonishingly fast, in terms of the technology and capability of contemporary armies, the time it took to construct this bridge enabled the Subei to not only conduct a war council, but also vacate their villages and join in a mass army of defense centrally located within their sphere of influence. The engineers who constructed the bridge enabled accomplishment of the strategic goals Caesar desired, but were unable to facilitate a surprise, or quick, attack. The slow speed of crossing did not enable immediate tactical success at this point in time. As a commander, Caesar only needed to ensure that he had the appropriate technical experts in his army, as almost all supplies and labor were found on site. The extensive timeframe for construction, while slow, was not of particular concern.

Speed of movement and maneuver became a larger concern as Europe developed and nations began to move out of the limited wars of positional strategy to one of annihilation, where the destruction of the enemy army was key to overall success. At the end of the 18th century the large, nationalist armies altered the scale of conflict, and required new ways of thinking about both offensive operations and logistics. The first nationalist army, the Grand Armee of France, was ably led by Napoleon Bonaparte. He

[6] Caesar, *Gallic War,* Appendix A. The structure was significant, and involved many aspects of technical engineering. To ensure a suitable foundation Caesar's army emplaced pairs of balks, driving them into the bed of the river with a floating pile driver to ensure stability. Piles, angled against the direction of the river on the downstream side, provided additional support in the event of increasing current. Trestles were built on top of this steady base, which consisted of interlocking beams, and the actual bearing surface was planks. Additionally, protective piles were placed upstream of the structure to deflect any attempts to destroy the bridge through deliberate introduction of debris into the river. The concept, of a base supporting structure, topped with planking, and protecting the structure from potential hazards with a structure upstream were continuous themes through World War II.

was a master of maneuver, using innovative techniques to ensure his victory through the application of force at the decisive point. Part of Napoleon's ability to meet the adversary on his own terms stemmed from the fact that rivers did not pose an insurmountable obstacle to movement of his large forces.

Napoleon's Grand Armee was a combined arms force. The standard infantry company consisted of 140 men, with six companies in a battalion. The cavalry was split into two types, the light and heavy, each with a specific purpose, but essentially still just a horse and rider. These units were supported by the field artillery, which included engineer units. Napoleon's meteoric rise to power started with an opportunity to show his capability directing artillery.

Although artillery had existed for some time, recent changes to the manufacturing process enabled the French to drastically reduce the weight of the pieces, making them usable as field artillery which moved with the relatively quick moving Grand Armee as opposed to fortification weapons for defense.[7] The new systems provided greater distance and a more economical weight to power ration, in addition to being used by multiple armies so that captured guns would benefit the attacking army. However, these increases in firepower meant a requisite increase in baggage trains, as the pieces of artillery still required horses to move them, their ammunition and powder, and a larger crew to

[7] George Nafziger, *Napoleon's Invasion of Russia* (Novato, CA: Presidio, 1988), 34-35. The initial system for manufacture was the Gribeauval system, a pre-revolutionary design. Consisting of 4-pound, 8-pound, and 12-pound shot weight, it weighed significantly less than the previous system. The post-revolutionary design, named System of the Year XI, adjusted the sizing to better reflect the commonly found ammunition on the battlefield. This removed the 4-pound and 8-pound size shot in favor of the more common 6-pound shot.

operate. Requirements for the horse pulling artillery included the ability to move 1,100 pounds across uneven terrain.

Napoleon's preference for quick wins through overwhelming mass and maneuver allowed him to reshape the European continent. The Grand Armee enabled operational maneuver through its use of engineering units, part of the field artillery. These units consisted of miners, engineer train units, sappers, and pontooniers. Typical of Napoleonic campaigning, two battalions of engineers, with a total of thirteen companies, stepped off with the Grand Armee in the campaign of 1812. Due to the weight involved with his massive armies, Napoleon mostly preferred to follow routes with bridges, as speed was vital to his particular way of war. This required the use of pontoon bridges. When crossing the Niemen River, French forces built three pontoon bridges over the course of 24 hours. This was primarily to enable the cavalry to cross the river, as many of the infantry soldiers crossed in boats. Important to note, the crossing was virtually unopposed, and so no direct confrontation affected the speed of construction and employment of the new ponton bridge.[8]

The Russian Campaign of 1812 ended in one particularly disastrous retreat, having been defeated far from France. Stretched beyond the capacity of his supply trains deep into Russia at the onset of winter, Napoleon's lines of communication were cut almost by accident, as the Russian Commander Chichagov followed vague orders to disrupt the ability of the French to connect two large armies.[9] Retreating from Moscow,

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[8] Adam Zamoyski, *Moscow 1812; Napoleon's Fatal March* (London: HarpersCollins, 2004), 148.

[9] Ibid., 458.

weather and constant harassment by the Russian forces attrited his forces rapidly. As the Grand Armee approached the town of Borisov, along the Berenzia River, en route back to France, the Russian defenders burned the bridge to the west. The failure to capture the bridge intact almost ended the Grand Armee as larger elements of the Russian forces closed from the east. During the campaign three days earlier at Orsha, in an effort to increase the speed of the column and out of necessity for the horses to pull artillery, Napoleon directed the destruction of his ponton train. General Jean-Baptiste Elbe, principal engineer for the ponton element, argued against but eventually complied with the order, minus a vital portion: he refused to destroy the mobile forges and associated tools which enabled his pontooniers to create a bridge out of almost nothing. This act of defiance saved the Grand Armee, when due to slightly warmer temperatures the Berezina River no longer lay under thick sheets of ice, but rather flowed with large chunks of ice in it at a relatively rapid rate. The river varied in depth but given the size and swift current represented a significant obstacle to cross unaided.

The bridge site in the town of Borisov, recently seized by the French, was not a suitable location for rebuilding due to the presence of Russian units on the west bank. As of yet, bridges were not built under threat of fire. It was thanks to cavalry scouts that a fording site in nearby Studzienka was found, with an average depth of six feet and about 20 yards across.[10] Without the pontons, General Elbe was forced to create wooden bridges, constructed out of the material of the nearby town, to enable movement across. Two bridges were required, constructed by 750 sappers, who obtained the wood for

[10] Zamoyski, *Moscow 1812; Napoleon's Fatal March*, 463.

construction, and 400 Dutch pontonniers, who actually constructed the bridges with some assistance of the sappers. The first bridge built took about twelve hours to complete and was designated for foot traffic only. Due to the weight and size of the wagons and artillery, a second, larger bridge was constructed nearby. It took about five additional hours to complete. Both bridges required constant maintenance, as the materials and planning going into the construction was hurried and in the worst of conditions. The freezing cold river swept away many of the engineers assigned to build the bridges; the exposure caused additional casualties as well. Skillful use of deception by Napoleon kept the majority of Russian forces away from the bridging site and enabled virtually unopposed construction. Had the French faced a determined enemy in defensive positions on the other side of the river, the result of the operation would likely have turned out very differently. As it was the army of Napoleon successfully crossed.

The choices that Napoleon made were potentially the correct ones at the tactical level, given his army's poor condition and the loss of horses pulling the artillery. However, when General Elbe argued against complete destruction of the only expedient bridging option available to the army, Napoleon failed to appreciate the implications on his operational movement and maneuver capability. Commanders now needed to understand both the capability and limitations of engineer units, and how changes could affect the rest of the army.

Shortly after the Napoleonic era society and warfare changed rapidly due to the industrial revolution. In addition to the ability to mass produce materiel, equipping armies of great size quickly and effectively, the increased use of rail contributed to an accelerated speed of war, mobilizing great armies across distance in unheard of time.

During this industrial era, weapons development increased the lethality and range of both individual and crew served weapons. New rifles capable of hitting a target at over 600 yards and effective mobile artillery created killing grounds on the battlefield never seen before. Tactics and strategy had to adjust to the new reality of these weapons. As the world adjusted to the increased use of artillery, larger and therefore heavier types were developed. Ranging in size from the 6lb piece to the heavy 24lb gun, these pieces could weigh as much as four tons with the associated equipment. This increase in weight continued to cause problems with river crossing. Unlike Europe, with developed road and bridge networks, the American network left something to be desired. The massive armies in the Civil War were similar to those used in Napoleon’s time, but needed to move over larger distances.

With the additional weight of larger artillery pieces and the need for quicker movement, the bridge equipment options continued to develop and increase in capacity. However, the slow, cumbersome movement of the European style of ponton bridges decreased their operational effect as long logistical trains and shortages of equipment impacted the ability of commanders to maneuver around the battlefield. The traditional ponton bridge consisted of a series of long wooden boats similar in construction to canoes, strengthened with copper or other metal, which were 22 feet in length and weighed 1100 lbs. These boats were transported on special carriages designed for the boats, one per carriage. The transport system included the associated requirements for construction and emplacement, such as oars for steering the boats in position and the wooden decking required for the bearing surface. As a point of reference, a single carriage of the European style ponton carried approximately 21 feet of bridge. To cross a river 350 feet wide, it would take 17 of these carriages and a large number of men.[11] The individual boats were launched from their carriages by a team of five men and steered into position near the bank, where two boats were connected via wooden decking to create a raft of sorts. Although this set up enabled some rafting options, the general lack of confidence in the overall stability of the rafts precluded their use for extensive rafting options. Once constructed, these partial bridges were moved into position and assembled in the river, using the planks as the stiffening element in the bridges. This general set up of ponton bridging, as well as the associated methods of construction and employment, remained unchanged from the Napoleonic Era and through the Civil War.

The US Army found this ponton system complicated and restrictive. Experiments conducted by the Army Corps of Engineers in the 1840s resulted in a new system which appeared far superior to the European style. Created by COL John F. Lane, the India Rubber Air Pontoon system drastically reduced the logistical impact and set up time. Instead of individual wooden boats, the Air Pontoon system used multiple layers of canvas, soaked in a proprietary gum resin which rendered the material watertight.[12] The

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[11] Quartermasters and Ordnance Department, *Reports on India Rubber Air Pontoons and Bridges* (New York, NY: Daniel Farshaw, 1849), 11.

[12] Ibid., 15. The boats were replaced by a system consisting of three cylinders 18 feet long and 18 inches wide in the shape of a boat, slightly pointing towards the riverbed. This increased the stability of the individual pontons, and supposedly increased the safety of the boats. Unlike traditional boats which were open on the top and could fill with water in choppy conditions, these pontons were sealed and rode low in the water, which would reduce the likelihood that a bullet or shrapnel would cause a tear and reduce the capacity of the bridge. The cylinders were also further subdivided into three sections, where the middle portions provided the support of the load on the bridge and the ends assisted in the stability of the bridge. This compartmentalization also reduced the likelihood of puncture, deliberate or otherwise, of the cylinder by protecting the load carrying section. By connecting three of these cylinders together, COL Lane further

pontons weighed only about 120 lbs, and therefore were moveable by a two man team, as opposed to the previous five man team it took to launch the traditional ponton boat. As the ponton was not a solid object, but rather an expansible bag, the Air Pontoon system required much less space for transport. Condensing down to a small box, the entire system for crossing a 350 foot wide river was transported in a single wagon. Through the use of standard bellows and a check valve on the ponton, the two man crew for a ponton could set up the ponton in about five minutes, and then move it into position themselves.

Wooden planking was still required for decking, to span between the pontons and also to protect the pontons themselves from any potential tears or other events which would degrade the structural integrity of the ponton. The design of the ponton, with three cylinders in the shape of a boat, increased the stability of the rafts created. Testing indicated that 50 men could safely transit a river on a single raft. Testing also included artillery, both for weight of transport and for the impact of firing while on the raft. Although not a common occurrence in a combat assault over a river, theoretically the new Air Pontoon system was capable of supporting even the 6lb artillery firing while on a raft.

In European armies the pontons were included in the trains following the army. Doctrine of the day held that as the need for use arose, the ponton train was called up to the front and put to work. This method, given the large amount of transportation and number of men required to set it up, kept the use and control of these specialized units at the army level. Smaller individual units did not have access to, nor capability to maintain,

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increased the stability of the system, and produced a total bearing surface for the ponton of 4.5 feet.

the pontonniers. However, with the advent of the Air Pontoon system, the possibility of lower distribution and decentralized control of the assets arose.[13]

In time, the Air Pontoon system revealed a few fatal flaws. First and foremost, the rubberized canvas of the pontons degraded over time from the inside, rotting to the point of failure. Secondly, after more testing and actual use by units it was found that the light weight of the pontons resulted in excessive rocking, which proved difficult for animals to move over. Lastly, the possibility of puncture through either sharpshooters or river debris continued to weigh on the minds of those using the system.[14] Although heavy and hard to transport, the wooden ponton boats of the French system were durable and structural issues were easily discerned and potentially repaired. However, the experiments which resulted in the India Air Pontoon system were not a total loss, as they provided the basis for future developments in ponton equipage in World War Two.

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[13] Quartermasters and Ordnance Department, *Reports on India Rubber Air Pontoons and Bridges*, 20. Although the initial reports on manufacture and testing of the new system focused mostly on the constructability, ease of transport, and capacity of the bridges, there was also recognition of the possibilities created. In the final reports there were notes on potential changes to organization, going so far as to suggest that individual companies should maintain and train on one single wagon of the new system. If so arranged, the leading company to arrive at a river could set up and deploy the Air Pontoon system across before the enemy was even aware of a potential breach of its natural obstacle defense. Alternately, if opposed in crossing, the stability of the rafts led to suggestions to ride the raft downstream past the defenders and land where a suitable location could be found, effectively negating the river as a defensible feature. While aggressive in nature, the specialized nature of the system and the massive quantities involved in equipping each individual company with the system was beyond the capability of the industrial base, as it was a proprietary design. Noted in the reports, certain imitators of the system lacked the watertight seals and stability, rendering them unusable as substitutes.

[14] U.S. Army Corps of Engineers, *Ponton Manual* (Washington, DC: Government Printing Office, 1915), 5.

Despite the widespread agreement that the new system was superior in transportability and deployability, the army continued to rely on its stocks of more standard, and durable, ponton bridges. Still, the time it took to transport the units from the storage depots to the front lines where they were deployed led to delays. In 1862, General Burnside, stopped by the banks of the Rappahannock River had to wait multiple days for his bridging equipment to arrive.[15] The additional time provided by the delay only increased the defensive posture of the Confederate line, and therefore the number of casualties. The stilted maneuver of the war, exacerbated by the lack of equipment, contributed to the non-decisive nature of the conflict.

The American Civil War was an exceptionally bloody and intense war, which impacted the future conduct of the army through its exposure of important issues with the pre-Civil War systems. The conflict, which spanned from the Atlantic Ocean to the Mississippi River, covered an expanse of terrain which contained numerous rivers and other impediments to travel. While the Union was able to maximize use of its rail system, enhancing its ability to move forces around the battlefield and enable efficient use of its industrial capacity, the southern states lacked a comparable rail system. This forced the Union and Confederate armies to rely on more traditional movement, namely foot and horse transportation. Road networks were vital to operations, and bridges were chokepoints of vital importance.

The armies fielded by the two sides were large, mainly consisting of standard infantry, cavalry, and artillery units. The order of battle for the Army of the Potomac in

[15] Robert Toguchi, "The Evolution of United States Army River Crossing Doctrine and Equipment, 1918-1945" (Dissertation, Duke University. 1994), 9.

June of 1864 identified almost 70,000 men in the headquarters element and five subordinate corps. Support elements existed, but were minimal in comparison to the rest of the armies. As the war progressed, this limitation in the number of enablers created problems, particularly for mobility and survivability. With the increase in the lethality of the small arms due to longer range and greater accuracy, army units attempted to minimize the impact by using more significant field fortifications and strong points, especially in the defense. Both movement and defensive works, while the responsibility of the infantry and cavalry commanders, were the purview and specialty of the engineer units.

A comparison of the Army of the Potomac order of battle from 1862 to 1864 shows a clear change that attempted to improve the ability of the maneuver units. The initial organization of the army held the Volunteer Engineer Brigade, which consisted of the 15th and 50th New York Engineer Regiments and the U.S. Engineer Battalion, as part of the Artillery Reserve. This unit, separate from the various corps units, reported directly to the Army of the Potomac headquarters.[16] While this method enabled tight control of the units, it also delayed response time and required significant coordinating efforts to ensure the appropriate units were with the various elements. As the war progressed engineer units were reassigned to lower levels. The 1864 order of battle shows the Engineer Brigade now as a direct reporting unit to the Army of the Potomac headquarters. Additionally, and more importantly, there are battalions from the 50th New

[16] Army of the Potomac, 5 April–5 May 1862, Nafziger Collection, CARL Library. Based on U.S. War Department, *The War of the Rebellion, A Compilation of Official Records of the Union and Confederate Armies* (Washington, DC: Government Printing Office, 1882), 5.

York Engineer Regiment now with the corps elements. II Army Corps kept 1st Battalion, 50th New York Engineers as a part of its headquarters. VI Corps followed suit, with the 2nd Battalion.[17]

Not every corps element had an associated engineer unit. V Corps did not identify any engineer element. However, despite not having trained engineers, IX Corps identified acting engineer units in its 2nd and 3rd Divisions. The importance of having individuals identified, and presumably minimally trained, led to the use of the 51st New York Infantry Regiment and 17th Michigan Infantry Regiment as acting engineer units. These units were kept as divisional assets, at the same level as the infantry brigades and the artillery units. This meant that three of the four corps assigned to the army contained identified engineer elements to support the overall engineering effort. These units were therefore capable of emplacing the three ponton trains necessary for the movement of the army during the 1864 campaigns.[18] The cavalry division, like the V Corps, lacked identified engineer support. However, this was in keeping with the purpose of the cavalry unit as a highly mobile element, with minimal artillery support. Cavalry units, when faced with a water obstacle, were generally directed to swim their mounts across in the event a standing bridge did not exist. Regardless of cavalry units not requiring a bride unit, there weren't enough ponton trains to supply all the corps elements with their own capabilities.

[17] Army of the Potomac, 30 June 1864, Nafizger Collection, CARL Library. Based on U.S. War Department, *The War of the Rebellion, A Compilation of Official Records of the Union and Confederate Armies* (Washington, DC: Government Printing Office, 1882), 1.

[18] U.S. Army Corps of Engineers, *Ponton Manual*, 8.

From the time of Caesar to the Civil War, rivers simply delayed a determined adversary. Improvements in technique and materiel enabled Civil War armies to construct a temporary floating bridge capable of supporting infantry, cavalry, and horse-drawn artillery. This was substantially faster than the week it took to construct a semi-permanent bridge only capable of supporting Caesar's infantry and cavalry. However, throughout this range of time periods the weight bridges had to support was limited by what a man or horse could carry and remained relatively light. Despite challenges in speed of construction, few doubted that the bridges created would support the anticipated loads. Also, few bridges were constructed under fire from the enemy, as commanders chose locations best suited to quick construction which often meant unoccupied territory. That all changed with the advent of mechanized warfare.

CHAPTER 3

POST CIVIL WAR TO INTERWAR DEVELOPMENTS

After the Civil War multiple boards were set up by the Corps of Engineers to evaluate all manner of operations, not least of which dealt with the issue of river crossing. Based on experience in the Civil War there were multiple issues with the US Army's method of river crossing, and no entirely obvious solutions. Both doctrine and equipment needed updates to ensure that future wars were not constrained by the ability of the army to cross the rivers found in such abundance in the continental United States. Given the small size of the standing army, as most Civil War units had been inactivated after the end of the war, the few individuals remaining were focused mainly on the westward expansion efforts. This involved protection of the borders from internal threats of Native Americans resisting the settlement of western territories, while not ignoring the threat of foreign invasion on the eastern coast.

While the majority of the early 20th century conflicts centered within the borders of America, there were a few forays into projecting forces into foreign theaters of war, namely the Spanish American war, response to the Philippine Insurrection and American support to the Boxer Rebellion suppression. However, none of these conflicts prepared the army for the large scale conflict of the Great War. This chapter looks at the ways the army engineers attempted to solve the issues found during the Civil War prior to entry into World War I, and how they adjusted after returning from the first major projection of power into Europe.

Soon after the conclusion of the Civil War the Corps of Engineers convened a board which was directed to report on the use and improvement of the "ponton equipage of the United States Army". Consisting of three officers, the board took a year to consider the qualities required for future employment and the capabilities of current stocks of ponton equipage, providing its recommendations in June of 1869. Thorough in its evaluation of historical use, European knowledge, and application in an American context, its recommendations were adopted merely five months later.[19]

The *Ponton Manual* of 1915 opened with a discussion of the board's proceedings, to explain the rationale of the decisions made. Beginning with a brief history of the ponton use and development through the Civil War, the board focused on what characteristics were required for the future army: bridging assets must keep pace with the army, provide ferry capability, and enable a floating bridge capable of supporting the heaviest loads in the army. Recognizing the difficulty in reconciling the first and third aspects, the board looked to European countries which had experience with this type of operation. The French system, consisting of large wooden boats, the Austrian system, consisting of smaller sectional boats, and the Russian system of canvas boats were all constructed and tested for viability. Testing revealed that the French system provided the best overall performance with regards to all three criteria, in particular with stability of the bridge. However, the light weight and ease of construction of the Russian canvas bridge system led to its adoption for advance guard units, commonly cavalry which did not have the larger artillery and other heavyweight requirements of a normal army train.[20] This further specialized the engineer units responsible for emplacing the bridge

[19] U.S. Army Corps of Engineers, *Ponton Manual*, 5.

[20] Ibid., 9.

equipment, and added more complexity to the planning a commander would have to evaluate in his operations.

Another aspect which concerned the board was suitability of the ponton equipage in all types of terrain and weather. The Civil War disabused the army of any expectation of fair weather only fighting. In particular, the effects of ice action on the pontons directly imperiled the capability of the canvas boats in the advance guard system. Therefore, weather constrained the use of these boats during winter months and other options were required, such as rafting or use of wooden boats. Weather in the late summer months was also considered, in terms of low water levels. In the event the boats were used in a low water situation, their internal strength would have to support the weight of the trains even if resting on the bottom. Initial attempts to make the ponton boats out of a metal material, or another combination of materials revealed that the only suitable, easily maintained material remained wood. Based on the French design, with some minor tweaks, the army decided to keep the wooden boats for a majority of the ponton trains, with a few canvas boat ponton trains for the advance guard. These systems, originally used in the Civil War, remained unchanged as the United States entered World War I.

The Civil War also revealed the difficulties in mobilizing large formations which operated in a similar and coherent way. Doctrine at the beginning of the Civil War consisted mainly of a few infantry manuals, heavily influenced by French military theory. Although doctrine was developed, the biggest issue was dissemination of these methods. Within the professional army, knowledge of doctrine and general principles of warfare were fairly uniform. This was primarily due to the extremely small size of the army, as well as the large percentage of officers coming from a single point of entry to the military: the United States Military Academy at West Point. The coherence of this baseline for regular engineer officers enabled the army to expand quickly for the leadership, but the individual soldier and junior leaders sought much more information than was easily available at the time.

The primary doctrine for the Army just prior to the Civil War was written in 1855, in the form of *Infantry Tactics*. Written by Henry Halleck, it drew heavily from the French, as most military manuals of the day did.[21] However, the number of new officers in a rapidly expanded army far exceeded the number of manuals. Private publishers provided various other drill and associated manuals, but the proliferation of different thoughts on tactics and strategy only further limited the ability of the army to operate. This issue was true on both sides of the conflict. To make matters worse, even those that did have a copy of the true doctrinal manual often found it confusing. The increase in lethality of weapons found on the battlefield created problems with the formations and execution on the field. The official doctrine called for faster movement on the battlefield to combat the increased firepower, which in theory would reduce the timeframe of exposure and reduce the impact of direct fires at a distance.

Over the course of the war multiple refinements were made to doctrine, but little changes of substance affected the ideal conduct of operations. Only when mass casualties began to attrit the armies did serious changes to doctrine occur. Attempts were made in 1862 and again in 1867 with an updated *Infantry Tactics,* but despite some minor

[21] Walter E. Kretchik, *U.S. Army Doctrine; From the American Revolution to the War on Terror* (Lawrence, KS: University Press of Kansas, 2011), 71.

individual initiative and small unit tactical improvements, both documents still relied on massive formations which remained vulnerable to massed fires.[22] Both documents were also still focused on infantry tactics as the major arm of military power.

Transformative change would not occur until the turn of the century. A growing movement towards German doctrinal concepts, validated in limited wars fought overseas such as the Boxer Rebellion response and the Spanish American War, overcame the institutional affinity for French military tactics. The change in mindset, from the massed army of attrition to one of small unit initiative, also sprang from continual improvements in small arms effectiveness. More importantly, the changing doctrine was supported by both the military and civilian elite in the War Department. Led by Secretary of War Elihu Root in 1904, multiple service schools were established which covered pre-commissioning to senior service levels of command. He also restructured the Army Staff to enable group input into war plans and doctrine development.[23] These reforms helped minimize the disconnect between future leaders of the army and doctrine. It also increased understanding and simple awareness of doctrine, key to an expansible army.

As a result of these changes, in 1905 a new keystone army document was created: *Field Service Regulations*. Based on the German style of warfare, the new manual provided increased instruction in both preparation of conventional forces for war and execution of action in the field of battle. While the threat of invasion waned from military consciousness, having successfully projected power through a few small foreign wars, the

[22] Kretchik, *U.S. Army Doctrine; From the American Revolution to the War on Terror*, 80.

[23] Ibid., 109.

doctrine writers recognized that some of the complications of American terrain rendered certain organizations less viable. The division replaced the corps as the primary unit of organization for war. Training enabled units to understand the role of the brigade and division elements through provisional units established solely for training, as neither size element existed in the peacetime force structure.[24]

Aside from establishment of schools and the organizational changes, the reforms called for more coordination between the services to achieve success. Discussions of logistics, staff organization, and communication between command posts held a similar level of detail to the tactical actions previously found in the infantry-centric doctrine of the last century. While every contingency imaginable was not addressed in the regulations, theoretical concepts which applied to virtually every situation were highlighted and the operations a division would most likely face were considered in detail.[25] Although the infantry still held primacy, the interaction of the other arms was becoming increasingly important.

From the engineer perspective, the organizational and doctrinal changes were reminiscent of the end of the Civil War. An engineer battalion was now part of the new divisional structure, much as the Army of the Potomac moved the engineer assets from strictly army level down to the corps level, and in some cases down to the division level

[24] Kretchik, *U.S. Army Doctrine; From the American Revolution to the War on Terror*, 111.

[25] War Department, *Field Service Regulations; United States Army, 1905* (Washington, DC: Government Printing Office, 1908), 5-9.

by the end of the war.[26] The divisional engineer troops in the new battalion consisted of a headquarters, three pioneer companies, and one ponton company, reflecting the required engineer efforts of the troops. As field fortifications and siege warfare were the primary concern of tactical units, the composition of troops were heavily skewed in those capabilities. However, the requirement for individuals trained on the ponton equipage, who were familiar with the unit they supported, kept the single ponton company as part of a standard division organization. Engineer troops still existed at the corps and army level, although different authorities existed at each level. Staff officers assigned to the division held no command authority over the subordinate units, but were rather coordinating and planning entities to advise and support the division commander. Interestingly, despite the newfound appreciation of combined arms, the 1905 Field Service Regulations specifically forbade the engineer and artillery units from communicating directly without going through the commander first. As the US Army was a commander-centric organization, this required the field commanders to understand and be responsible for the coordination of the various specialty units within the organization.

While the 1905 Field Service Regulation spoke about the composition of the engineer elements, and had recommendations as to location within the march, it spoke little of actual employment. Tactical advice consisted of use of engineer officers in the advance guard to conduct evaluation of the routes and bridges and inclusion of the ponton train in the reserve of the advance guard. Obviously the engineers themselves required

[26] Ibid., 12.

more detailed information, as their operations were complex. Execution involved a large number of commands which non-engineer troops did not receive training on, as it took weeks to become proficient on the various systems used. In order to train sufficiently, engineer specific doctrine was required and found in two documents published just prior to the Great War, namely the *Ponton Manual* of 1915 and the *Engineer Field Manual* of 1918.

Begun in 1889 under the direction of the commandant of the Engineer School, the *Engineer Field Manual* originally consisted of six parts, covering topics from reconnaissance to bridges to animal transportation. The work was developed by the Engineer School, but as it contained many technical aspects it was peer reviewed not only within the military, but sections were also sent to other combat arms and civilian engineers for comment. All told, this process took seven years and multiple revisions to become a coherent document, but by 1906 the first true edition of the field manual was published. In the intervening years until the beginning of World War I, there were five major revisions made, with the final pre-war edition published in the beginning of 1917.[27] This work contained updates to the six previous sections and inclusion of an additional section concerning scientific tables for use in detailed engineering work.

The purpose of this field manual, with its highly technical analysis and detailed discussions concerning civil engineering, was to provide a single reference manual for engineer officers in charge of units. Too abstractly technical for the average engineer soldier, the manual described how to calculate the live load on a bridge given structural

[27] War Department, Engineer Field Manual, *Parts I-VII,* 3rd ed. (Washington, DC: Government Printing Office, 1918), 5.

members of particular dimensions and assumed composition.[28] In other words, there was a limited audience for this version of the doctrine. In terms of bridging, the focus of chapter 2, there was useful information on the construction of ponton bridging, but it amounted to less than a fifth of the 110 pages in the chapter.

Within the twenty or so pages devoted to ponton and other floating bridges, a brief description of the organization of bridge engineers and of the ponton equipage ensured that all engineer officers understood what sort of support a particular unit had. Using some simple calculations, an engineer staff officer determined what the maximum weight in a given unit was, compared it to a table of bridge capabilities, and decided if any alteration in the general construction method was warranted. In the event of unusually heavy loads there were modified construction techniques, despite the belief that the normal set up could support the heaviest loads in the army. In some cases distances between the pontons could be shortened, but in the extremely heavy cases additional materiel was required in addition to shortened spans. This type of information required advanced planning due to the limited amount of bridging materiel normally carried in a unit. Otherwise a unit was restricted to using ponton ferries. Although crossing a river was possible in this manner, the additional time and vulnerability made it far from the preferred option.[29]

With the primary doctrine being so complex and detailed, the man on the ground still lacked directive guidelines on how to actually construct the various forms of field

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[28] Ibid., 159.

[29] Office of the Chief of Engineers, Engineer Field Manual, *Parts I-VII*, 3rd ed. (Washington, DC: Government Printing Office, 1909), 215.

expedient bridges; most importantly, the ponton bridge equipage carried with the army. One solution to this dilemma was the creation of the *Ponton Manual*, published in 1915 and again in 1917. Based off the previous instructional document of *The Bridge Equipage of the United States Army* from 1870, this more user friendly guide provided the detail needed by the engineer on the ground actually constructing the bridge.[30] This manual contained the jargon and commands necessary to coordinate the construction, identified the positions and responsibilities of all parties involved, and did it in a manner most people with minimal familiarity with the equipment would be able to follow. Further, as previously mentioned, the manual explained the rationale and history of the army's choice in ponton equipage.[31]

Interestingly, the manual dedicated to ponton operations covered much more than just specific instructions related to construction. Recognizing that even ponton bridges required significant effort and were vulnerable to a myriad of threats, the manual actually begins with discussion of fording operations. Followed by a discussion of the bearing capacity of ice, the manual goes through an increasingly complex set of options for crossing a river in the first chapter. The second chapter clearly identified what the bridge

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[30] Office of the Chief of Engineers, *Organization of the Bridge Equipage of the United States Army with Directions for the Construction of Military Bridges* (Washington, DC: Government Publishing Office, 1870). This early instructional manual contained only five chapters and covered primarily the ponton bridge construction. A brief discussion on fording operations and a small section on trestle bridges in support of railways were the only areas outside of ponton drill discussed.

[31] U.S. Army Corps of Engineers, *Ponton Manual*, 5-10.

equipage consisted of, both heavy and light, and what a unit could expect to accompany it, down to the number of sail needles.[32]

While the first two chapters clearly articulated that the use of the ponton was the most efficient mode of transport across a river, and standardized the load plans of the trains, it was the third and fourth chapters which had the bulk of useful information for the emplacing engineer. Chapter 3 held the drill for use of the boats (or pontons), down to the individual commands, clearly articulated. This instructional material was useful for training, and revealed the need for previously trained engineers to be on hand for emplacement of these bridges. Although not overly complex, the commands and jargon were complicated and not a skill to be learned by infantrymen during the emplacement, potentially under fire.[33] Multiple drills, taught at the company level and called "schools" provided instruction for new privates on how to handle boats, coordinated use of multiple boats at a time, and what particular verbal instructions meant. These lessons were vital to success, as many operations were conducted in low light scenarios to minimize the likelihood of discovery.

Chapter 4 provided the details of construction, from the selection of a site, to the actual techniques to ensure a stable bridge from shore to shore. Of note, the very beginning of the chapter discusses the selection of the bridge site as a compromise of

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[32] Ibid., 34. This section constituted an inventory and load plan for the wagons which were included in the ponton equipage train. These items were vital not only for emplacing the pontons, but for maintaining them as well. While the unit which controlled the trains did not emplace the pontons themselves, they were responsible for the maintenance of the equipment while it was in transit.

[33] U.S. Army Corps of Engineers, *Ponton Manual*, 52-59.

tactical and technical considerations, with tactical issues being the deciding factor in event of conflict. While the paragraph described terrain features of interest, whether the presence of concealment in the approach or high ground on the opposing shore, the enemy was not discussed as a part of the tactical considerations, which may have exacerbated the coordination issues of the infantry and artillery with engineers when confronted with an opposed crossing, as no information regarding these coordinating efforts existed.[34] Perhaps most importantly, the process points to the tactical commander as the final arbiter of any conflicts between technical and tactical considerations. The commander determined crossing points, time, and what support the engineers would receive. It was here that the commander became responsible for the crossing. .

As the United States prepared to enter World War I, the army stood on a relatively solid doctrinal base, or so it thought. The publication of the army-wide Field Service Regulations and branch specific supplements, such as the Engineer Field Manual, provided a level of consistency never before seen. Specific, complex operations, such as river crossings, had their own manuals which got into the specifics of the drill. However, these documents supported an army more similar to the Civil War than World War I due to one significant change: the invention and mass use of the internal combustion engine. The internal combustion engine changed the world in many ways. Traveling distance, once limited by the endurance of the individual or the horse, expanded at an incredible rate. Much as the train revolutionized travel between large cities, the cars and trucks in use by the time of World War I enabled more rapid movement throughout the entire

[34] U.S. Army Corps of Engineers, *Ponton Manual*, 60.

countryside. Road networks were in the process of improvement to allow more comfortable travel and vehicles became more commonplace. While something of a specialty item, by the early 1900s the use of the assembly line by Henry Ford meant that more people could afford cars in the United States. As with many inventions, militaries around the world immediately looked for a way to maximize the potential of this new capability. The obvious use of trucks for logistics and cars for travel of VIPs, perhaps the most innovative and historically significant use of the internal combustion engine was the introduction of the tank.

The use of armor dates back to the beginning of warfare. Shields evolved into suits of armor, for both the horse and rider. Naturally, this tendency to encapsulate an individual and the mode of transportation transferred to the vehicles powered by the new engine. The first tanks were developed in Britain, in an effort to break the stalemate of trench warfare on the European continent in World War I. However, with the increased mobility provided by the internal combustion engine and defensive armor, the rivers and trenches which existed in Europe had to be crossed, sometimes with disastrous results. Heavier than most military equipment used at the time, the tank required reassessment of the bridging assets in the army. Permanent and semi-permanent bridges, built with steel or heavily reinforced timber, were previously designed as railroads already existed throughout the developed world and required bridges to span the same concerns of rivers and gaps. However, these structures took time and effort to put into place, neither of which an advancing army had to spare. Therefore, an increase in capability of the standard ponton bridge appeared the best answer for the time. The quickest fix, the addition of bearing surface planks and a decrease in spacing between pontons, meant that the logistical train for the ponton units grew and the number of available units initially shrank.

The United States remained neutral for the first years of World War I. During that time the Army published multiple revisions of the Engineer Field Manual in preparation for actions in Europe. The 1918 Engineer Field Manual, *Part II. Bridges,* still dealt primarily with classification of fixed bridges. The loads considered mainly consisted of the usual military men and equipment, namely infantry, cavalry, and lightweight field artillery. Added to the typical equipment in the tables, 1.5- and 3-ton trucks were listed with the associated maximum weights, however tanks are notably absent from the calculations.[35] As tanks were introduced in European armies only in 1917, this omission reflected the inexperience of the American army with the new mechanized weapon. This inexperience would have greater impact in the following years, as the size of the machines grew at a greater rate than the supporting bridges.

As the army began to seriously investigate its role in the European conflict, General Pershing established his headquarters in Paris, France in late May 1917. The staff quickly determined that generating an army large enough to have significant impact would take time. Additionally, even if generated quickly, the army would take a long time to arrive in theater due to limitations of transport capability and port throughput.[36] As part of his efforts to understand the conflict General Pershing sent out teams from

[35] Office of the Chief of Engineers, Engineer Field Manual, *Parts I-VII*, 3rd ed., 214.

[36] Office of the Chief of Military History, *United States Army in the World War 1917-1919* (Washington, DC: Center of Military History, 1988), 3.

each branch of service to learn about their counterparts in the other allied nations. The engineer team spent most of June with the British Army, partly in England at their engineering schools, and partly in France with the field army. The team then spent a large part of July with the French army, again both at schools and with field units, to learn as much as possible about the specific challenges in the theater of operations.[37]

In the report, the mission identified some significant challenges for the new American Expeditionary Force's engineer units. They noted that the sheer volume of engineer units in operations was daunting, and that the myriad of specialized units conducted military engineering missions not previously considered the purview of American engineers. Discussions with the British indicated that the requirements of engineers resulted in a massive expansion in terms of numbers, with establishment of dozens of new specialties. Although not specifying the changes required, the mission noted that after some experience it would be highly likely that modifications to current doctrine would be necessary.

In terms of bridging, the mission noted the importance both the British and the French held in keeping the ponton trains ready for use. Noting that both motorized and animal drawn trains existed, the primary location for ponton trains of each country was at the corps level. With such a rapid expansion of their armies, both allied countries ran schools for the bridging units, which would be recommended for new American units.[38] As the front stabilized and the dilemma of trench warfare confronted the allies,

[37] Office of the Chief of Military History, *United States Army in the World War 1917-1919*, 82.

[38] Ibid., 83.

development of short "trench bridges" added to the diversity of engineer materiel in the equipment parks and requirements for training of forward engineer units.

Although the notes on foreign army engineer practices were helpful for future training and consideration regarding organization and employment, the mobilizing American Expeditionary Force relied on previously published works, such as the Field Service Regulations and Engineer Field Manual. After arrival in theater, units were further trained at the Engineer School at Langres, France. As part of this training, six days were devoted to bridging. While ponton units were specialized and more highly trained in bridge building, other engineer units were often called to assist in the construction of the bridges.[39] The 464th and 465th were the only ponton units to serve with the armies, each with a specialty. The 464th worked along the Marne River, using captured and repaired German equipment. The 465th trained with the French equipment at Langres.[40] It is important to note that each company was trained in a particular style of equipment, further specializing the specialists.

While the engineers received training on the equipment, some of the shortcomings of the doctrine revealed themselves when American units began to operate in Europe. As

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[39] War Department, *Historical Report of the Chief Engineer including all Operations of the Engineer Department; Allied Expeditionary Forces, 1917-1919* (Washington, DC: Government Printing Office, 1919), 137. Staffed with French and British instructors, the school in Langres taught relatively raw recruits the particulars of working with the allies in the unique environment of the western front. Further, as logistic issues resulted in difficulties with equipment arriving in theater, the schools also provided an opportunity to learn about the foreign equipment the American engineers would rely on in the execution of their duties. As the reliance on foreign equipment complicated matters, each corps also trained their incoming engineers in the basic skill required for their sector.

[40] Ibid., 91.

the 5th Division, part of 3rd Army Corps of the American Expeditionary Forces, crossed the Meuse River, multiple issues presented themselves in the conduct of operations. Receiving orders to cross on the night of 2 November, 1918, 7th Engineers prepared a new type of ponton footbridge to enable quick crossing by the infantry units. Begun in the dark of night, the operation went well until the Germans, not more than 200m away, noticed the work at dawn. Although the river itself was bridged, a canal adjacent to it remained a problem. A lack of artillery support and combined arms integration meant that the engineers and infantry who had crossed the river were pinned down for the entire day under withering machine gun fire by the defenders on the opposite bank of the canal.

In the afternoon, after reports of Germans fleeing the area from air reconnaissance, the division was ordered to bridge the gaps with equipage suitable for artillery movement. The small footbridges, set up just the night before, were no longer suitable, and in fact needed to be removed due to being in the optimal spot for bridging operations. The 7th Engineers lacked organic ponton equipage of suitable capacity, so French materiel was borrowed from 33rd French Corps. On the evening of the 3rd, new footbridges were installed to establish a bridgehead on the far side. While construction of the bridges went relatively smoothly, the German defense was tenacious and the Americans ran out of ammunition before they were able to break through.[41] The lack of coordination between artillery, infantry, and engineers for a forced river crossing, which was a scenario absent in doctrine of the time, resulted in two failed assaults in as many days.

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[41] CPT Viner, 5th Division Monograph, CARL Digital Library, 12.

The following day a forward observer directed fire, to great effect and enabled the crossing. After clearing out the initial German positions, artillery fire began to fall short, destroying the two footbridges which crossed the canal. This required the engineers to rebuild them, while under intense fire from the flanks. Once rebuilt, enough combat power was crossed to remove the rest of the German positions, but at a much higher cost than necessary had the various units coordinated a forced river crossing from the beginning.

After the conclusion of the war, the army discussed many of the issues it faced in operations such as this. Mechanization and motorization had fundamentally changed the speed of war. The scope of war also seemed to exceed the scenarios put forth in doctrine as it stood prior to the war. The army realized the importance of revising its Field Service Regulations of 1923 to deal with the faster pace and larger scope.

During the Interwar period the engineer branch also re-evaluated its doctrine. Recognizing the potential risk inherent in another rapidly expanded army consisting of newly trained individuals, built around a core professional army, the engineers updated the Engineer Field Manual and produced the *Advanced Engineer Manual* of 1933. As a result of the massive size of units seen in World War I an organizational change occurred.[42] Engineer units now fell into one of two categories; General Service or Special. General Service engineers consisted of those assigned to the divisions in General

[42] War Department, *The Advanced Engineer Manual*, 2nd ed. (Washington, DC: National Service Publishing, 1930), 5. The manual noted that at the end of World War I there were over 300,000 officers and men in the army, in over 40 different types of engineer units.

Service Regiments, and those in non-divisional units as separate battalions. Special engineer units included camouflage, railway, map, and of course ponton units.

The new units also changed the focus of the organizations. Instead of being a reactive element, the expanded staffs and additional units sought to become proactive. Engineer work was to be completed in time to meet the needs of the combatant troops, through sensing the need in advance, estimating and planning for the operation, and arranging material to maximize work potential.[43] This was possible with the delineation of duties in a large theater, with separate command elements for the theater, communications zone, army, corps, and division. While each of these echelons had responsibility to assist in planning, command relationships remained fully with the combat commanders. The division engineers controlled all engineer elements within the unit, following the directives of the division commander. If additional resources were required for a particular operation, requests were sent up to the next echelon for assistance.[44]

The special units, controlled by corps or army level organizations, were then attached in support of specific operations. Bridging units, which made up about 15% of the engineer units, consisted of Heavy Pontoon battalions, Light Pontoon companies, Heavy Bridge trains, and Light Bridge trains. Although similar in composition to the previous doctrine, the use of engineer units was much more defined in the new manual. Engineer troops were part of the advance guard, particularly when river obstacles were

[43] War Department, *The Advanced Engineer Manual*, 9.

[44] Ibid., 28.

identified. Ponton units marched between the advance guard and the main body of the unit, so that "it should never be necessary to halt the column while bridge equipage is being brought up."[45]

The execution of the bridging operation was also further refined. Reconnaissance of the river line was conducted by engineers attached to the scouts. The bridgehead, now an officially recognized requirement, was seized by first swimming infantry across, followed by footbridges and ferries if necessary. Once the bridgehead was seized, the ponton bridge was installed, to be replaced by a more permanent bridge at the earliest possible point so that the equipage could be taken down and returned to the unit for future operations.[46] While not necessarily revolutionary in concept, the inclusion of these steps further encouraged integration with the associated units and standardized the methodology of the river crossing.

Finally, the doctrinal equipment in World War I was still the Civil War style. Although extensive use of French equipment reduced the usability of American doctrine, as the war progressed and tanks became a larger part of the battlefield, engineer officers recognized the limitations in the capacity of American bridge equipment. New heavy and light models of ponton equipage, with increased capability were developed in 1924 and 1926 respectively. However, due to manufacturing limitations, the old Civil War style

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[45] War Department, *The Advanced Engineer Manual*, 31.

[46] Ibid., 36.

bridge equipage remained in the new doctrine to ensure that in a rapidly expanded army at least institutional knowledge would still exist for employment.[47]

While limitations in army doctrine and equipment was identified during World War I, the Interwar period was marked by slashed funding, mass demobilization, and a desire for peace. Therefore, although the professional army attempted to rectify the issues previously seen as a result of World War I, few substantial changes occurred. The army moved from basic Field Service Regulations in 1905 to more complex conceptual documents in FM 100-5, which is discussed in chapter 4. For the engineers, the lack of detail in the first set of doctrine, as seen in the early Engineer Field Manual, gave way to user friendly instructions found in the Advanced Engineer Manual. Integration of the combat arms improved, but there were still issues with equipment capacity and employment. It would take the start of another World War before these issues were addressed.

[47] War Department, *The Advanced Engineer Manual*, 205.

CHAPTER 4

THE SECOND WORLD WAR

The Interwar period spanned twenty years, from the conclusion of World War I in 1918 to the beginnings of World War II in 1939. Although the United States did not officially enter the war until Pearl Harbor was attacked in December of 1941, the struggle on the European continent was impossible to ignore. Therefore, for the purposes of this paper, the Interwar period ends in 1939 and preparation and mobilization begins thereafter. Despite a strong desire for peace, the armed forces clearly understood that involvement was not only likely, but almost an inevitability. As the Army watched the developments of the land war, so unlike the final struggles in World War I, drastic changes were required to meet the new threat of a more mobile and lethal battlefield, not least of which included contested river crossings.

Engineer doctrinal development through the Interwar period, as shown in the previous chapter, was mostly technical in nature. The Army as a whole lacked uniform doctrine across the force, at least which was understood and practiced. The capabilities of the German Army, moving some of its armored forces in such rapid fashion as to coin a new term of Blitzkrieg, clearly surpassed that of the United States. Despite resistance to entering another major conflict so soon after completing the first world war, the U.S. Army leadership understood that war was more likely than not, and that America required significant changes in size, composition, and training if it was going to compete on the international stage. In order to accomplish this task, by the end of World War II the army created and promulgated viable river crossing doctrine.

When World War II began the United States found itself needing to rapidly expand the professional army once again. As the war raged on the European continent the United States again maintained neutrality, but without the isolationist bent that controlled preparations for the previous World War. Recognizing the likelihood of entering the war, the army began preparations to expand the pool of available men for service. Supported slowly by Congress, appropriations began to fund a series of exercises and testing the scale of which had never before been seen. However, before significant training could occur, the service had to confirm the doctrine to use in the upcoming war. This resulted in early publication, and seemingly constant revision, of the Field Service Regulations, now renamed FM 100-5 *Tentative Field Service Regulations.*.[48] The Engineer branch also began publishing updated doctrinal references, starting with FM 5-5, *Troops and Operations*, bringing the previous Engineer Field Manual up to date with the new doctrinal numbering system.[49] What did the new doctrinal manuals focus on, and how effective were they for actual units in combat?

The analysis of the doctrine, and its many changes, falls into three categories. First, how well did the doctrine prepare commanders and their staffs at the higher levels in planning and setting conditions for successful river crossings? For the purposes of this

[48] War Department, Field Manual 100-5, *Tentative Field Service Regulations, Operations* (Washington, DC: Government Printing Office, 1939). The FM designation was in keeping with the new doctrinal numbering system. Although the 1939 version was published and accepted as a training manual, it was still tentative until the fully approved version came out in 1941 (without the tentative modifier). The 1941 edition officially replaced the previous 1923 Field Service Regulations.

[49] War Department, Field Manual 5-5, Engineer Field Manual, *Troops and Operations* (Washington, DC: Government Printing Office, 1941).

analysis, and to remain consistent with the doctrine itself, higher levels consist of division and above elements.[50] Second, how well did the doctrine support the tactical leader in executing his mission? This focuses on the elements below division. Finally, how well was the doctrine understood and applied in training? This question, still asked in today's Army, looks at whether the conditions set for training enabled the doctrinal approach, or if soldiers at all levels simply made the mission happen regardless of doctrine.

At the Army level, the doctrine of the United States had been initially developed during the Interwar period. *A Manual for Commanders of Large Units (Provisional)* was published in 1930. The sheer size and scope of the World War I experience had revealed the United States lacked standardized doctrine for units such as an Army Group. Lessons learned in that conflict are evident throughout the manual, highlighting the need for combined arms integration, and the emphasis of peacetime training for large unit staffs.[51] However, limitation on that training, due to resource availability in terms of land and the scope of exercising units of this size, require most training to consist of map problems and staff exercises. In the preparation for World War II, prior to the mass mobilization efforts in the later 1930s, these units existed on paper only, so no training occurred, and few organizations executed this training.

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[50] War Department, Field Manual 100-5, *Tentative Field Service Regulations, Operations,* 2. While it is commonly understood in today's Army that the division deals with the tactical level, the doctrine of the time considered the division as the lowest level planning headquarters. It functionally separated the manuals, as FM 100-5 dealt with operations below division, and FM 100-15 focused on higher elements.

[51] War Department, *A Manual for Commanders of Large Units (Provisional)* (Washington, DC: Government Printing Office, 1930), 10.

While the manual did not directly address the various branches, activities at river lines were specifically mentioned. The complexity and unique characteristics of river crossing operations required coordination at higher levels, and thus were part of the Special Operations chapter. Portions of the section suitably prepared leaders for planning, identifying the preferred timeline of pre-dawn attack and the need to use feints to confuse the enemy with regards to the actual crossing site. The importance of assigning engineer efforts and bridge assets to the supported divisions and the use of salients to maximize offensive firepower on enemy defenses all remain in line with doctrine throughout World War II. However, the manual also contained precepts which were detrimental to leaders and planners. The recent mechanization and motorization of the world's armed forces led to an incorrect assumption that mass movement was dependable and capable of surprising the enemy at key locations such as bridge and crossing sites.[52] Aside from the fact that bridge sites were historically prime defensive sites, the idea that a mobile offense could seize a bridge by virtue of speed alone focused planners on the rapid movement and maneuver of the infantry units and reduced emphasis on planning for a forced crossing. While optimistic in nature, the impact at the tactical level meant an increase in risk due to a potential lack of appropriate equipment and units.

Towards the end of World War I new technologies displayed more potential to affect the conduct of war, namely air power and the development of tanks. These specialized units altered the composition of larger units, introducing new formations into the system. The Army needed new doctrine to address these units and introduced them in

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[52] War Department, *A Manual for Commanders of Large Units (Provisional),* 67-68.

the updated version of the Manual for Large units, now renamed FM 100-15, Field Service Regulations, *Larger Units*, published in 1942.[53] The lag in time between large unit doctrine publications may be attributable to the focus on tactical development and inclusion of the new capabilities as seen in FM 100-5, *Operations*, which is discussed further in the next section.

Concurrent with the development of new doctrine, the Army evaluated its force structure to ensure that units maximized the potential of the new technology. Specifically, the square division of World War I, where each infantry division consisted of four infantry regiments, was cut down to a triangular division of three infantry regiments. The idea, to increase mobility, also led to reductions in support personnel, including engineer units. Going from an engineer regiment in support of a square division to an engineer battalion in support of a triangular division, the relative amount of engineer support did not change significantly initially. However, after some testing, the engineers suffered additional cuts and went from 3.5% to 1.7% of the division's strength.[54] This cut was made possible by reductions of special units, such as bridging, from divisions and elevating their control to corps or higher levels.[55] These specialized units were slower

[53] War Department, FM 100-5, Field Service Regulations, *Larger Units* (Washington, DC: Government Printing Office, 1942).

[54] Blanche Coll, Jean Keith, and Herbert Rosenthal, *United States Army in World War II, The Technical Services, The Corps of Engineers: Troops and Equipment* (Washington, DC: Office of the Chief of Military History, 1958), 12.

[55] Ibid., 15. Many specialty units were moved up to corps level. However, even the corps level lost bridging assets. In the old system the corps had a light ponton company as part of its engineer complement. In the new system no such unit existed and the additional separate battalions were also moved up to the army level.

than their maneuver counterparts, so conceptually the reduction made sense, despite the protestations of the Corps of Engineers. However, when the updated doctrine was released, a gap in planning appeared.

When FM 100-15 was finally published, there organization of the manual underwent a massive overhaul. Where the 1930 version focused on the units by size and then type of operation, the 1942 version switched to focus more on commonalities in operations and a relatively small discussion of individual units. Most obvious in the table of contents of each manual, this shift in emphasis reflected the need for units to coordinate and understand the operations of all elements in the theater. The manual contributed to a better understanding of the overall operations of large units, regardless of type, as it focused on staff planning and considerations, which were much more appropriate for large units. However, in terms of river crossing operations, the new manual had one notable deletion: any discussion of considerations of special circumstances.[56] This section, albeit small and at the end of the last manual, was where the broad planning considerations of the large units in specialized operations resided. Although the tactical considerations of the operation clearly exceeds the scope of this manual, the organization of the Army at the time held the engineer units capable of supporting such an operation at the large unit level, corps or above. This meant that the units which were required to provide the support did not have doctrine which mentioned the importance of planning for this unusual type of operation. While overall development of large unit doctrine improved, the removal of river crossing considerations from large

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[56] War Department, *A Manual for Commanders of Large Units (Provisional),* Table of Contents.

unit planning processes negated the benefits of a more coordinated and expansive manual.

The primary document for units below division leading up to World War II was the *Field Service Regulations* of 1923. This was the coordinating doctrine for combined arms operations at the tactical level. As war approached in World War II the Army updated its foundational doctrine and published the 1939 version as a tentative field manual. A quick comparison of the introduction of the 1923 and 1939 versions of highlights a significant shift in thought with regards to applicability of doctrine. In 1923, the manual applied to large units and any smaller units therein, with the Division size element as the basis for discussion.[57] The 1939 manual introduced the new numbering system, and more importantly the use of field manuals to further define tactical application of doctrine.[58] FM 100-5, *Operations,* still applied to the higher tactical levels of planning, but for the first time there was acknowledgement of what lower lever leaders had been clamoring for: tactical doctrine usable by those charged with executing the operational plans.

This detailed tactical doctrine began internally with the Engineers, with the publication of the *Advanced Engineer Manual,* which focused on training new engineer officers in all the requirements of their new jobs. While comprehensive for its time of publication, 1933, it recognized that the development of motorization and mechanization

[57] This stands somewhat in conflict with the *Manual for Commanders of Large Units* which also claimed the division element as part of its doctrinal span of control.

[58] War Department, Field Manual 100-5, *Tentative Field Service Regulations, Operations,* ii.

would create future issues with control and supply, which would rapidly change in the coming years due to technological innovations in the private sector.[59] Testing of mechanized and motorized units were considered but incomplete by the time of publication. Additionally, while used as a training aid, this publication was not a government publication, but rather a supplemental to cover a gap in doctrinal manuals available. Endorsed by the Chief of Engineers, it was privately published in an attempt to standardize, or at least assist in the development, of training at colleges for reserve officers. One of the concepts emphasized was that time, not money, was the currency of the combat engineer, an important distinction in a peacetime army more focused on the constraints of budgets on training than the life and death implications of operations.[60] The last official doctrinal manual, the *Engineer Field Manual* of 1918, held no discussion of motor vehicles and their impact on the battlefield.

In 1941, the updated version of the *Engineer Field Manual* was published, in the new system of numbering as FM 5-5: Engineer Field Manual, *Troops and Organization.*[61] The new tactical doctrinal manual addressed many of the concerns of division and below leaders. Integration with other branches, along with their specific needs and considerations, featured prominently. Despite changes in organization from square to triangular divisions having started years earlier, the manual accounted for both types in case the rapidly expanded army had any legacy units still operating. It also

[59] War Department, *The Advanced Engineer Manual*, Part I, 299.

[60] War Department, *The Advanced Engineer Manual*, Part II, 1.

[61] War Department, Field Manual 5-5, Engineer Field Manual, *Troops and Organization* (Washington, DC: Government Printing Office, 1941).

introduced the Engineer Battalion (Armored) and the Engineer Regiment (Aviation), new units designed to support the budding branches.[62] Each of the sub-branches of the engineers, from general combat units to railway and water supply units, found a place in the new manual. With regards to river crossings, two chapters in particular were important.

Chapter 6 focused on ponton units, both light and heavy. With detailed descriptions of all parts of the respective companies it is important to note that while the ponton companies provided expertise, they were not the ones charged with the actual construction of the bridge.[63] Rather, the general engineer units assigned to the various lead combat elements (each division had a general service engineer regiment) were tasked with the actual construction once they received the materiel from the ponton company. Further, while the footbridge and assault boat sections would join the supported engineer element early on, the ponton platoons did not attach themselves until a designated control point. In terms of planning the actual assault, this meant that the ponton companies became more logistical supply companies than actually involved in the assault.

The doctrinal design of engineer units had the general service engineer element with the unit planning and executing the construction of the bridge. However, in terms of training, the individuals in these units had minimal training opportunities to actually construct a bridge, which as seen in earlier, more technical manuals, was still a

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[62] War Department, Field Manual 5-5, Engineer Field Manual, *Troops and Organization*, 8.

[63] Ibid., 108.

complicated procedure. Without training on the equipment, the efficiency and pace of construction were adversely affected.

Chapter 13 dealt with specific operations of complex and complicated nature, including river crossings. Referencing FM 100-5 from the outset, it is clear that the expectation for understanding is in the tactical realm for combined arms integration. However, immediately following in the second paragraph is the following statement:

> Units higher than the division are concerned primarily with fixing the general time of crossing and with designating the fronts and major objectives for subordinate units. *They attach the necessary additional engineers and equipment to front line divisions and hold initial reserves of engineers and equipment under their own control* to be used later to reinforce the front-line divisions or to exploit a success. A front-line division prepares a general plan for crossing on its front. Subordinate units work out details on fronts assigned them under the division plan (emphasis added).[64]

This stands in contradiction to the amount of detail regarding river crossings found in the 1942 version of FM 100-15. In general, the assumption was that centralization would maximize efficiency in employment of the engineer specialty units. While division elements had combat engineer units within their force structure, the numbers and expertise for special operations was not needed or present. Therefore, higher level elements contained the specialty units and attached the requisite resources as necessary. If larger units, above division, were responsible for allocating all the equipment and troops necessary for a successful crossings, it should be reflected in the doctrine at that level. Within the division structure, the specialty units attached to the division such as ponton companies were held under the control of the division engineer.

[64] War Department, Field Manual 5-5, Engineer Field Manual, *Troops and Organization,* 248.

However, assault boats and foot bridges were attached to the individual infantry companies conducting the crossing.

With the myriad ways with which an engineer units were attached, employed and tracked, the importance of training took on great importance. Training followed a natural progression of individual training at a multitude of small training sites, increasing in complexity to small unit and company level training. Understanding that the size of the conflict required armies, not brigades, the army began a series of large scale maneuvers to exercise headquarters not used in a peacetime army. The most famous of these, the Louisiana Maneuvers, occurred in 1941 on the Louisiana and Texas border across an operational exercise field large enough to accommodate two full size armies in direct engagement. Unlike previous exercises these maneuvers were unscripted, with each side receiving minimal orders and expected to conduct reconnaissance and plan their own attacks. Using a complex system of umpiring, the General Headquarters (GHQ) attempted to inject as realistic effects as possible into the exercise. Umpires for each type of unit, ranging from the individual infantry company to air umpires riding with the air force, determined the results of each engagement and declared the winners.

A large part of the maneuvers was devoted to testing out new systems of organization. In particular, the transition from the square division used in World War I to the triangular division found in World War II found support as a result of these exercises. The trauma of trench warfare and stalemate during the Great War remained fresh in the minds of both military leaders and politicians. The wave tactics used previously were no longer acceptable in the same manner. The army desperately desired a return to maneuver warfare, and the change from the square to triangular division appeared to streamline that movement and capability. However, the unintended consequence of realignment meant that all non-essential service elements were pulled to higher headquarters. This included the engineer efforts, particularly the specialized elements such as bridge units.

Engineer engagements in the Louisiana Maneuvers, as recorded by the designated military historian Christopher Gabel, were thought out, but perhaps ultimately overly optimistic. As destruction of local bridges within the area of operations was not allowed, mock charges were used to simulate the emplacement of explosives, with the umpire determining the effectiveness of the charges and resultant destruction. While at least considered, the actual effects of the charges were not tested, at least at this juncture. In terms of bridging operations, most of the bridges were constructed with minimal, if any opposition. Therefore, only 1-3% casualties an hour, with a maximum of 15% per day[65], were assessed against any engineer unit. In an operation as complex as river crossings, loss of trained men could have serious impacts on the ability of the unit to conduct the crossing. With such minimally assessed effects of enemy action, this impact was never fully explored or considered. While the work of emplacing a floating bridge was relatively simple, an individual who did not understand their role in the process or the commands which were given to execute would have provided minimal assistance and potentially even hampered efforts. Therefore, use of infantry or other personnel to fill in any gaps, even in the short term, was not a truly feasible option.

While the engineers performed well during the course of the maneuvers, there still existed some concern about the time period required for construction of the bridges. Final

[65] Christopher R. Gabel, *The U.S. Army GHQ Maneuvers of 1941* (Washington, DC: Center of Military History, 1991), 47.

assessment of the engineer effort concluded that the engineers, in 3rd Army at least, were undermanned and underequipped.[66] This supported assertions that in real combat, when fully manned and equipped, the engineers would perform at a higher level and cross rivers of similar size to those encountered in the maneuver area at a higher rate of speed. However, it must be noted that the biggest successes of the exercises were constructed on previously improved sites.[67]

In addition to the structural changes, the equipment needed to be tested in relation to the new requirements. While some testing was done stateside prior to deployment overseas, many of the units had minimal time to train on actual equipment used in theater. To combat the common errors seen across the formations, the engineer units conducted testing and disseminated best practices via reports.[68]

Initial engineer doctrine focused primarily on the actual emplacement of equipment used by the engineers to accomplish the crossing. Early manuals identified that crossings were complex operations, not necessarily in terms of combined arms integration as it is understood today, but rather in terms of complicated drill to construct an expedient bridge in even good conditions. In particular, for a commander and his staff planning an operation, timelines for planning were virtually non-existent. While it could be argued that individual characteristics of each site make it impossible to determine

[66] Gabel, *The U.S. Army GHQ Maneuvers of 1941*, 102.

[67] Ibid., 71.

[68] These reports applied to various levels of command. See "Engineer Technical Bulletin No. 28" or Information Bulletin No. 120, *Stream Crossing Equipment*, for examples of these publications.

accurately the ability of a unit to cross within a given amount of time, there are areas of the operation which lend themselves to appropriate estimation.

While doctrine accounted for the theoretical coordination of movement, the practical application of the plan required estimates for travel time, amount of equipment and men which could be carried by each type of equipment, and tactics, techniques, and procedures (TTPs) to increase the likelihood of a successful crossing. The 181st Engineer Battalion conducted a series of tests in Belgium, on the Lac De La Galeppe Lake (see Table 1). While conditions on a lake are much simpler in terms of current and the fact there was no opposition to the landing, the engineers determined many useful TTPs with regards to the initial crossing.[69]

While the report openly acknowledged that the particular situation at the banks, both the near and far sides, directly impacted the time it would take to cross a river, there were aspects of the crossing which were more easily estimated. Namely, the time it took to cross about 1000' of river in the most common types of equipment on hand for a forced river crossing. Of equal, if not more, importance was the frank discussion of capable loading, in real assault composition terms. Conceptually, the various pieces of equipment had a nominal loading rate. However, operations in combat differ significantly from the testing conditions done safely stateside. This set of testing considered variables important to the success of the operation, such as the difference between ambulatory and litter patients, number of gas cans per trip, and acknowledged the difference between men

[69] 181st Engineer Battalion, "Capabilities of Heavy Ponton Equipment," Annex E, Appendix D, E.I.M. 28. World War II Participants and Contemporaries: Papers, Box No. Chronister, Clark Vernon Papers, Eisenhower Presidential Library Archives, Abilene, KS.

and well equipped men. Additionally, it considered the fact that engineer operators were required for a return trip, often multiple, due to the limitations in equipment availability.

Table 1. Technical data from Belgium Experiments

Craft Type	Passengers	Litter Patients	Gas Cans	Other Loads	Crossing Time	
					1000'	1500'
Stormboat	6-9	3 or 6	50	--	20-25 mph	
Ponton	50	20	240 or 260	up to 37mm AT gun	2'5"	3'
2 Boat Raft	--	deckload	deckload	4 ton truck	2'25"	3'15"
3 Boat Raft	--	deckload	deckload	M4 tank	2'45"	3'50"
Utility Boat	10	2	10	--	15-20 mph	
2 Halfboats	18	9-12	130	--	3'	4'
5 Halfboat reinforced raft	--	deckload	deckload	2.5 ton w/trailer	4'	6'

Source: 181st Engineer Battalion, "Capabilities of Heavy Ponton Equipment," Clark Vernon Papers, Eisenhower Presidential Library Archives, Abilene, KS.

While this information may appear too tactical in nature to be discussed in a larger level doctrinal manual such as FM 100-5, the discussion did not appear in the branch specific tactical doctrine of FM 5-5 either.

As the war progressed a large amount of information was shared broadly throughout the Army Ground Forces. Lessons learned through all the theaters were published through observation reports. While some of the lessons were mission specific, a theme ran through the reports that indicate the organizational structure of the Engineers was sound and supported by field commanders. As commanders at all levels gained experience, the decision to elevate the engineer assets to higher levels appeared to find validation. Army and corps notes in the Pacific endorsed the allocation of bridge assets, Bailey bridge in this theater, at the corps level. In particular, after action reports on the Hollandia Operation in New Guinea specifically stated "Division engineer units do not need to stock Bailey bridges in the combat zone if they are available to the corps engineer."[70] In addition to the distribution of equipment, the report highlighted the importance of training. While advocating for more night emplacement training, the report acknowledges that continuously changing directions for tactical units commonly resulted in confusion and failure to accomplish the training objectives.[71]

Separate from the engineer specific doctrine, it is important to understand and consider what the supported units understood related to river crossing doctrine. Specifically, as the infantry or armor commanders generally controlled the local engineer assets and made requests for additional support, what did they know about river crossing operations and how the engineers fit into their plans? How did their respective doctrine support integration of engineer assets in planning and execution? The infantry, long established as the basis of the Army, was the focus of most doctrine at the higher levels. However, armor formations were a new concept and a large part of the discussion

[70] Army Ground Forces, *Combat Lessons gained from Overseas Observations* (Washington, DC: Army War College, 1945), 97. The report identifies that having enough engineering assets on hand is not only important, but imperative. Each corps had no less than three full sets of Bailey bridging and as soon as practically possible, installed bridges were replaced with permanent structures to enable use of the Bailey bridge in future operations. The Hollandia operations occurred in the spring of 1944, which indicates that these allocations were still debated in the professional circles even late in the war.

[71] Ibid., 93, 97. The emphasis of night emplacement resulted from the hazardous conditions of daylight emplacement while under fire. However, night emplacement posed its own challenges, in terms of limited visibility and coordination within the emplacement team.

regarding engineer operations, as their capabilities depended on mobility to a much larger degree than infantry.

The armor branch, as a newly established entity, developed incredibly rapidly in the early 1940s. The first tanks, back in World War I, were slow, ponderous machines which were used to supplement infantry advances in the trench warfare of the period. Not designed for rapid movement, tanks were considered mobile bunkers. In order to ensure that the branch was able to move around the battlefield in World War II, a special new engineer unit, the Armored Engineer Battalion, was created. These units had the same general composition as normal separate engineer battalions, but due to the requirement for mobility in an advance, had an organic bridge company as well as four line companies and the headquarters company.[72]

As tanks were vital to the front lines, the engineer element supporting them focused on mobility tasks such as ferrying, hasty bridging and mine removal.[73] Training, begun at the Engineer Replacement Training Center, took two months according to the doctrinal timeline, but often was severely shortchanged due to mission requirements.

In terms of operations, the armored force was not designed for use in forcing a major crossing against an alert enemy, preferring to attack lightly defended or vacated areas to ensure that mobility was not compromised. When operating in armor pure formations, the branch deferred to the engineer elements within it for guidance on crossing, referencing FM 5-5 as the primary doctrine, with the division engineer

[72] War Department, Field Manual 17-45, *Armored Engineer Battalion* (Washington, DC: Government Printing Office, 1942), 2.

[73] Ibid., 10.

supervising the operation.[74] At least in this branch, operations were evaluated according to the doctrine of the experts, who were involved throughout the planning process.

Preparing for war is never easy. Changing the way the Army operated posed significant obstacles, which were evaluated during the Interwar period. Challenges included ensuring coordination between the many manuals, and various branches, involved in the operation. Although critical planning data, such as crossing time estimates, were absent from the doctrine, the conceptual theory was solid. The Army developed doctrine which worked, and promulgated it across the branches most involved. It expanded the number of manuals which addressed river crossings, and identified differences between operational and tactical concerns. It took into consideration the organizational changes of the Army, from square to triangular divisions, and included information for any units not yet completely transitioned to the new format. In short, the Army used up to date doctrine, which applied to all types of units. By the end of the war units were ready to conduct these complex operations.

[74] War Department, Field Manual 17-45, *Armored Engineer Battalion*, 72.

CHAPTER 5

APPLICATION OF DOCTRINE

The doctrine of World War II took a long time to develop, rapidly updating from 1939 to 1942. The Interwar developments, the rapid expansion and mobilization, and the significant changes in organizational structure all led to serious growing pains at all levels of command. Therefore, a suitable analysis of the effectiveness of doctrine would be undercut by reviewing early river crossing attempts, such as debacles like the Rapido River crossing in the Italian campaign. While many of the same issues potentially apply, the true test of the doctrine should stem from veteran units, who most likely understood the doctrine best and had the opportunity to become practitioners. It is then more appropriate to analyze the final push into Germany, when units had previously crossed multiple rivers of varying sizes, in different conditions, and against a well-entrenched and prepared defense. Only then can the suitability of doctrine be determined. In a case study analysis, the first requirement must thus be an operation which included a reputable river crossing organization. Secondly, as the doctrine changed over the course of the war, it is important to note which version was in effect at the time. Once the operation and doctrine have been identified, the operation can be analyzed for adherence to doctrinal models. Specifically, as in the preceding chapter, how close did the leaders and staff adhere to doctrine, and what was the result? A case study of the Third Army operations around the fortified city of Metz, Germany, indicates that the doctrine was sound when correctly applied, and perhaps more importantly, that units ignored the concepts of doctrine at their own peril. Failures to adhere to doctrine created conditions which doomed the operations from the start.

As the allies raced across France, breaking out of the Normandy beachheads and pursuing the German army through a wide variety of terrain, American units found themselves facing a large number of rivers. Some were small, more intermittent streams which required simple fording procedures. Others were much larger, such as the Seine, the Moselle, and the final natural protective barrier for Germany, the Rhine River. Slowly, almost to the point of suicidal stubbornness, the Germans retreated eastward. Large Allied armies raced to reach the Rhine in order to begin final preparations for the invasion of central Germany.

There were two main army groups in the northern sector of the western front focused on pushing east as fast as humanly possible, and planning for the eventual forced crossing required to enter the heart of Germany. 12th Army Group, under US General Omar Bradley, and 21st Army Group, led by British General Bernard Montgomery. As the Allied forces moved east in Europe, logistical issues with the rapid pace required concentration of effort along the western front. The general concept of operations for the final push to destroy Germany focused on breaching the final natural defensive line, and significant obstacle, of the Rhine River. After much discussion, the decision was made to focus materiel and men on the northern portion of the Rhine, in 21st Army Group. Therefore, the limited amount of gasoline being brought in over the Normandy shore went to 21st Army Group in support of clearing the Calais area[75]. It has been noted that the effective combined bombing campaign, designed to disrupt the ability of the Germans to reinforce the Normandy area, severely restricted the ability of the Allies to resupply

[75] Martin Blumenson, *The Patton Papers* (Boston, MA: Houghton Mifflin, 1974), 537.

their own formations going through the same area. Even when supplies were arriving in mass quantities, the difficulty in transporting them to the front proved an unanticipated logistical challenge. In the meantime, 12th Army Group provided support and potentially a second axis of advance from the south once resupplied.

However, reality and chance drastically changed the course of plans for the initial breach of the Rhine River. It was 12th Army Group's elements who first crossed and led the assault in March of 1945, all thanks to a single railroad bridge located in Remagen. The Germans, having failed to destroy the Luddendorf Bridge during the approach of the Allied forces, enabled the First US Army, under LTG Courtney Hodges, to seize the bridge and far shore before enough combat power could be generated to stop the Allied assault. Despite an unsuitable location, congested road network, and lack of planning for a crossing at that time due to the total surprise at taking the bridge mostly intact, the Allied forces were able to establish a bridgehead and then construct appropriate bridges to exploit their windfall.

Prior to this operation there was a race by all the units in central Europe to the Rhine. In an effort to reach it first LTG George S. Patton, commander of the newly formed Third US Army, famously drove across France so rapidly that he outran his logistics, stopping due to a lack of fuel to keep his mechanized and armored forces moving.[76] This culmination point occurred just west of the Moselle River, near the town of Metz. Despite his best efforts to obtain priority for pressing a successful attack, LTG Patton was only able to secure assurances of gasoline once 21st Army Group secured

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[76] Anthony Kemp, *Metz 1944* (Bayeux, France: Heimdal, 2003), 59.

Calais. Obviously discontent with the plan at hand, LTG Patton realized that waiting only benefited the enemy, noting that the field commanders in the 12th Army Group were all for pressing the attack immediately.[77]

A historically fortified city containing numerous strong points alongside a major river, what became to be known as Fortress Metz posed a considerable obstacle. The fort system consisted of an inner and outer ring. The inner ring, originally used for infantry defense of the city, had fifteen forts which provided some protection to the defenders but lacked the large caliber weapons that the outer ring held. The outer ring, covering a larger distance, had 27 forts which held artillery and larger contingents of German defenders.[78] This system of fortifications was further protected by numerous rivers and other bodies of water that would slow any advances into the city by an opposing army. The Moselle, a large and swift river running in mostly a north-south direction, obviously posed the greatest challenge. At the time of the assault on Metz, the river was swollen due to recent rain, which created mud along the banks and increased the speed and unpredictability of the river basin.[79] Compounding some of the difficulties normally associated with a river crossing was a canal system, the Canal de la Moselle, adjacent to the river, effectively creating dual rivers to be crossed in many areas. However, breaching these two obstacles alone would not enable encirclement of Metz. The Seille River runs effectively parallel to

[77] Blumenson, *The Patton Papers*, 537.

[78] XX Corps, *The Reduction of Fortress Metz, 1 September–6 December 1944*, Operational Documents–CARL Digital Library, 49.

[79] Fifth Infantry Division, *The Fifth Infantry Division in the ETO* (Nashville, TN: Battery Press, 1981), 93.

the Moselle, directly into Metz itself. East of Metz ran the Nied River, perpendicular to the Seille. In simple terms, multiple river crossings would be required to achieve success in reducing Fortress Metz.

The Germans, having occupied the town for a few years, understood the strengths and weaknesses of the position, and were well entrenched on the eastern bank, if undermanned and supplied. Home to a training center for replacements and new officers, Metz was the local seat of Wehrmacht power, with offices for the Waffen SS and multiple organizations present in the city. According to the commander of the training division, MG Krause, by 22 August 1944 recent Allied success had sent many German units eastward, to the point he received orders to begin “orderly processing” of the disorganized retreating units.[80] Any men suitable for combat were collected and reassigned to units, either in defense of Metz itself or for reconstitution of other units. The forts, while numerous, had fallen into a state of disrepair, with some of the original material having been sent north to Normandy. MG Krause was appointed commander of Metz on 2 September and in preparation of defense of the fortress city, ordered the rehabilitation and reorganization of the defense assets.[81] Larger caliber guns, up to 15 cm, were refurbished and manned by the Officer Candidate School personnel, who serendipitously graduated on 1 September at the beginning of the battle.[82] However, without the proper sighting mechanisms, the guns could only be direct fired. Despite a

[80] MG Walter Krause, “Defense of Metz 1 to 18 September 1944”, trans. LTG Gustave Hoehne, 1946, 2.

[81] Ibid., 10.

[82] Ibid., 5.

serious lack of artillery ammunition, and concern about the capability of the ad hoc formations used to defend the city, MG Krause and his defenders tenaciously fought to maintain control of the fortress city.

Facing these defenses was the US Third Army. Within Third Army LTG Patton had two corps, XII Corps, led by MG Eddy, and XX Corps, led by MG Walker. He assigned the task of securing the southern sector of the Third Army area of operations to XII Corps, using XX Corps in the northern portion.[83] This unit consisted of the 5th and 90th Infantry Divisions, the 7th Armored Division, and the 3rd Cavalry Group.

According to their unit history 5th ID "crossed more rivers than any other division."[84] Regardless of potential hyperbole, the unit had crossed many rivers along the route to the Moselle, and were an experienced team as part of XX Corps. Additionally, assaulting Metz in 1944 was not their first time across this river.[85] In WWI the 5th ID crossed the Moselle, canal and all. Like many WWI era units, they were reorganized as a triangular division in preparation for WWII.[86] This occurred prior to the unit participating in the Louisiana maneuvers.[87] These large scale maneuvers, the largest ever performed in the United States, were designed to test the doctrinal changes proposed prior to entry to

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[83] MAJ Argersinger, MAJ Johnston, MAJ Nettala, CPT Murphy, MAJ Rossi, MAJ Taddonio, "Moselle River Crossing: 5th Infantry Division, September 1944" (Advanced Battle Analysis, Combat Studies Institute, Ft. Leavenworth, KS, 1983), 12.

[84] Fifth Infantry Division, *The Fifth Infantry Division in the ETO,* 2.

[85] Ibid., 6.

[86] Ibid., 8.

[87] Ibid., 10.

WWII. This meant that 5th ID received training on the most current doctrine prior to deploying to the European Theater of Operations (ETO). During a stop in Ireland en route to the ETO, the division engineers practiced river crossing on small Irish lakes, as the rivers were too small an obstacle for realistic scenarios. This continual training showed a dedication to understanding one of the most complex operations a unit attempts. With many successful river crossings along the way, the XX Corps was ready, trained, and able to assault across the Moselle to take Metz.

Although records clearly show that the XX Corps was properly trained prior to arriving in the ETO, as the doctrine changed constantly, it is questionable if the most recent publications would have been in the hands of the staffs planning the assault. However, for the sake of argument, and as the 5th ID was known to be an excellent river crossing unit, for the purposes of this paper the latest published edition of each manual provides the basis for comparison to doctrinal methods. Changes to the river crossing portion of these manuals did not constitute a large percentage of the various updates, either changes to current editions or new rewrites, which occurred during the war.

At the higher levels, the most recent edition of FM 100-15, *Larger Units* was published in 1942 and FM 100-5, *Operations*, was published in 1944. These were each the final edition published during the war, although *Operations* was updated again shortly after the war in 1949. They represent the most comprehensive doctrine produced during the war, and contained changes resulting from lessons learned throughout the war.

At the more tactical level, there were three suitable manuals. First, FM 5-5, *Engineer Troops*, and FM 5-6, *Operations of Engineer Troop Units*, were both published in 1943. These most recent updates to tactical doctrine incorporated some of the lessons learned from the North African Theater of Operations. FM 17-45, the *Armored Engineer Battalion*, was published in 1942. While not as recent, it held the most up to date information regarding the particular nature of engineer support for armored forces, to include river crossings. Additionally, Information Bulletin No. 120 *Stream Crossing Equipment,* published under the authority of the Office of the Chief of Engineers in 1943, provided the latest data for bridge equipment.[88] Together with the larger unit manuals, these publications represented the best doctrine available to the Third Army, and XX Corps, in its preparation for crossing the Moselle, and then the Rhine.

The assault on Metz occurred in September of 1944. In an ideal world, Metz would have been taken in stride, much as Patton's Third Army swept across France. However, it was the end of the long drive across central Europe which ran into logistical issues, particularly with regards to fuel. As previously discussed, both the logistics and the resultant decision to focus effort on 21st Army Group stopped Third Army cold in its tracks. The delay significantly contributed to the difficulty in crossing the Moselle, as the remnants of the German units defending the fortified city received multiple units of reinforcements and were able to further entrench themselves in their defensive positions before the first assault. Instead of facing a relatively light level of opposition, Third Army now faced a prepared and determined foe in good positions. As LTG Patton wrote to his wife, "we have had a desperate battle forcing the Moselle which we could have had for the asking had we not been required to stop."[89] While the delay was outside the control of

[88] Office of the Chief of Engineers, Information Bulletin No. 120, *Stream Crossing Equipment* (Washington, DC: Government Printing Office, 1943).

[89] Blumenson, *The Patton Papers*, 548.

the Third Army, the situation should have affected planning for future operations in a more direct way than actually occurred.

The culminating point for XX Corps was in the town of Verdun. Having reached the city on 31 August, both the 7th AD and 5th ID strictly rationed their remaining fuel, focusing on reconnaissance missions in hopes that once fuel arrived in quantity the offensive could restart quickly and effectively. Using captured fuel, small recon parties were able to keep eyes on the major Moselle river crossings, including spending five days, from 1 to 5 September, in mobile positions next to the river. However, maps used by the XX Corps had no indication of the fortifications, nor the details of the terrain suitable for proper military planning.[90] Additionally, despite having eyes on the river, apparently no specific crossing sites were identified for the initial push across.

As the Moselle was a large river crossing obstacle, it is appropriate to now begin analyzing the ability of Third Army and XX Corps to adequately plan and resource the impending crossing. According to doctrine, forced crossings should be conducted across a wide front, with multiple separate attacks.[91] The Third Army front was indeed wide, covering final objectives from Coblenz in the north to Mannheim in the south.[92] It has been argued that the size of the XX Corps front, estimated at 40 miles in length, exceeded the ability of three divisions to successfully cover.[93] However, with such a large zone of

[90] XX Corps, *The Reduction of Fortress Metz, 1 September–6 December 1944*, 2.

[91] War Department, Field Manual 100-5, *Operations,* 1944, 229.

[92] XX Corps, *The Reduction of Fortress Metz, 1 September–6 December 1944*, 59. This is based off of the higher headquarters mission, listed in Field Order 10.

[93] Gabel, *The Lorraine Campaign*, 19.

operations, XX Corps had plenty of riverfront to choose for an assault across the Moselle. Despite the size of the front, XX Corps knew it would have to take the town of Metz, as it was the largest city in the zone.

In the days just prior to the assault on Metz, XX Corps tried to use a deception plan by sending two armor task forces in a feint towards Sedan, supposedly to maintain contact with the southern flank of First Army and draw personnel away from the defense of Metz.[94] This is in keeping with the contemporary doctrine to make every effort to mislead the enemy and reduce the amount of defenders in the actual zone of operations.[95] However, the first actual order for the operation, issued for 6 Sep by MG Walker would not adhere to some of the key principles found in doctrine.

The first issue with the initial XX Corps plan, and by extension the Third Army plan, lay in the stated objectives of the operation. Field Order 10 was issued at 2300 on 5 September. It identified the objective of Third Army as the seizure of crossings of the Rhine River between Mannheim and Coblenz.[96] The ultimate objective for XX Corps was a river crossing in the vicinity of Mainz, with the additional mission of being prepared to continue the advance and seize Frankfurt. This was over 130 miles east of Metz. Although crossing the Moselle and seizing Metz is mentioned in the first specified task of the corps, it appears a given that Metz would be easily captured or bypassed by the 7th Armored Division, who were directed only to contain strong enemy positions

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[94] XX Corps, *The Reduction of Fortress Metz, 1 September–6 December 1944*, 1.

[95] War Department, Field Manual 100-15, *Larger Units* (Washington, DC: Government Printing Office, 1942), 25.

[96] XX Corps, *The Reduction of Fortress Metz, 1 September–6 December 1944*, 59.

until the infantry divisions arrived and relieved them. In fact, in 7th AD's specified tasks, seizing a crossing of the Moselle is notably absent, despite knowledge that most, if not all, normal bridge crossings were destroyed. Instead, the first directed task was to advance east and seize bridgeheads on the Rhine River. According to FM 100-15, when planning a corps advance, critical areas where enemy contact is expected should be evaluated and planned for, even going so far as to say that when the enemy is near, the enemy situation is the controlling factor in planning the advance.[97] Even if MG Walker did not have the best information regarding Metz's defenses, the knowledge that it contained a large number of forts and defensive works was common and should have required a more deliberate plan for the capture of such a large city. As the Moselle stood in the way of capturing Metz and moving further east, at the very least Field Order 10 should have directly assigned responsibility for the crossing. This failure to recognize the threat Metz posed to the overall objective, crossing the Rhine, resulted in minimal planning and a lack of guidance the division commanders soon required.

The first serious XX Corps crossing attempt occurred at Dornot. Located southwest of Metz, it was just outside the urbanized sprawl. XX Corps was directed to attack to the south of Metz, encircle it, and continue moving towards the final objective of the Rhine River. According to the plan, the order of march was listed as 7th AD followed by 5th ID on the south and 90th ID on the north, in a doctrinally recommended formation.[98] This arrangement implies that 7th AD was responsible for the initial river

[97] War Department, Field Manual 100-15, *Larger Units*, 59.

[98] XX Corps, *The Reduction of Fortress Metz, 1 September–6 December 1944*, 59. This document contains the order of march instructions. FM 100-15 lists three formations recommended for a corps level advance, with the formation used by the XX Corps being

crossing and bridging. Task organization further confirms this assignment with the attachment of the 206th Engineer Combat Battalion (minus one platoon) and the 991st Engineer Treadway Bridge Company. Had Third Army not been in constant static contact with the defenses around Metz, and able to achieve some semblance of surprise, this formation with armor leading and seizing the bridgehead matches what FM 100-15 recommends. It had worked in the lead up to this point during the drive across France.

In terms of general river crossing doctrine, this arrangement makes the most sense, as 7th AD was properly resourced with engineer assets for the crossing. As the heaviest unit, and the only one with an organic bridge company, having the 7th AD lead the assault ensures that the bridges are built in a configuration which would support the heaviest load. It is important to note that the armor divisions had an Armored Engineer Battalion, which unlike its infantry division counterparts had organic bridge assets as part of its Table of Organization and Equipment. This enabled these units to train on emplacing bridges without relying on additional support from corps and army level engineer units. Further, the treadway bridge company which was attached for the operation was specifically designed to support armor units.[99] If this bridge unit was the only one available to the XX Corps it would have been most advantageous to have the 7th AD lead the operation, as the infantry division would have had less experience with this particular bridge type. Notably, as neither the 5th ID nor the 90th ID have any

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second. The design of the formation is intended to increase flexibility, and protect both flanks.

[99] Office of the Chief of Engineers, Technical Training Bulletin No. 17, *Expedient Use of Fixed Steel-Treadway Bridge* (European Theater of Operations: Office of the Chief Engineer, 1944), 1.

additional bridge assets listed in their attachments, it would have been physically impossible for them to conduct the bridging operations. If the crossing had been done doctrinally, these infantry divisions would have led the assault, seized a small bridgehead, and cleared the area of direct small arms fire and observers for indirect fires. This would then enable 7th AD to emplace the bridges and move armor across.

However, the optimistic planning in having 7th AD lead failed to take into account the enemy situation. The decision to have 7th AD lead the attack across the Moselle is perhaps the biggest deviation from doctrine in the assault on Metz. Although tank doctrine was new, there were many lessons already being learned regarding the use of armor in an attack. The speed and mobility of the armor division constituted its greatest strength. If an intact bridge could be found and seized quickly, leading with armor was a sound, doctrinal method. However, as stated in FM 17-45 *Armored Engineer Battalion*, the armored division "is not particularly adapted for use in forcing a major crossing against an alert enemy."[100] The Germans in Metz, either involved in the defense of the city or withdrawing in the face of Allied attacks, were certainly an alert, and determined, enemy. Despite the obvious complications which would occur in the event an armor division was the lead element of an attack, the manual held remarkably little information on how to properly plan the crossing, instead referencing FM 5-5 *Engineer Troops* for the details. Mostly comprising a description of the various troops in each formation, this reference did not provide the requisite information for planning aside

[100] War Department, Field Manual 17-45, *Armored Engineer Battalion*, 69.

from identifying which types of engineer elements were available and preferable for a crossing.[101]

Field Order 10 described the engineer effort as focused on the 7th AD, with General Support for the corps as a whole, but following 5th and 90th ID.[102] This would be as part of the final corps trains, not in a position to rapidly deploy and support the attack. Doctrine to this point recommended that when anticipating crossing rivers to keep the engineer bridge units farther forward to ensure that enough resources would be available. Granted, the individual Engineer Combat Groups, the 1103rd and 1139th respectively, were tasked to support different formations than 7th AD. However, their position in the order of march reduced the flexibility of XX Corps to adjust to the situation on the ground when 7th AD ran into trouble obtaining a bridgehead and moving armor units across the river.

When a few recon elements reached the Moselle they verified that there were no intact bridges remaining. Though the requirement for a forced crossing was identified, as the official history of the Lorraine Campaign notes “no decision was made as to whether the division should fight for a crossing both north and south of Metz or . . . a single

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[101] War Department, Field Manual 5-5, Engineer Field Manual, *Engineer Troops* (Washington, DC: Government Printing Office, 1943), Table of contents.

[102] XX Corps, *The Reduction of Fortress Metz, 1 September–6 December 1944*, 60.

bridgehead."[103] Having had multiple days and significant recon assets out in force to determine the enemy situation, this seems particularly troublesome.

By the 7th of September the 23rd Armored Infantry, part of 7th AD, reached the Moselle in the vicinity of Dornot. This city, located southwest of Metz, featured a relatively simple crossing in terms of no complicating factors like the canal system that exists along much of the Moselle. An initial attempt to cross in assault boats was only partially successful, moving six companies of infantry into a small bridgehead. Further attempts to reinforce were repelled by direct machine gun fire and the unit sustained significant losses. In accordance with doctrine, the small bridgehead attempted to remove direct fire against the bridge site, but was unable to accomplish the task due to the enemy being inside large forts, which belonged to the outer ring of protective measures for Metz. In apparent disregard for doctrine, the crossing began during daylight hours and most of the companies crossed during the afternoon, when they were easily spotted and targeted by the defending force.[104] Simultaneously, 11th Regimental Combat Team, part of 5th ID, reached high ground on the west bank of the Moselle across from Dornot, following in the trail of 7th AD as per Field Order 10. As Dornot did not have a large transportation network, the large amount of forces operating within the city created havoc for the units as they attempted to organize for a crossing.[105]

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[103] Hugh M. Cole, *U.S. Army in World War II, European Theater of Operations, The Lorraine Campaign* (Washington, DC: Office of the Chief of Military History, 1950), 121.

[104] XX Corps, *The Reduction of Fortress Metz, 1 September–6 December 1944*, 4.

[105] Kemp, *Metz 1944*, 84.

Of note, from the German perspective, the engineer units coming to provide bridging assets were spotted. Although the unit which spotted the engineers was unable to engage due to lack of artillery ammunition, the nearest fort was able to engage the engineers and were credited with stopping the successful bridge crossing.[106] The timing of this crossing was not in line with doctrine, which specified early morning or even night crossings to utilize limited visibility, for this exact reason.[107] Engineer assets in the open, at a static location such as river crossing sites, are an easy target for artillery. It is also why the second stage of bridgehead development is to clear all positions which can observe the crossing site.[108] While this would be the doctrinal goal, the situation on the ground at Metz made it virtually impossible, with the rings of fortifications. Another method would have to be used to obscure the crossing sites instead.

At 1200 MG Irwin , commander of 5th ID learned that his unit was to pass through 7th AD and force a crossing at Dornot. However later in the evening MG Walker told MG Irwin to cross in the morning of the 8th.[109] Seeing that earlier attempts to use artillery to silence the defenders was ineffective, the security and secrecy of night operations was the best chance of success. The 8 September attack was directed through a defile, narrow and flanked on the opposite bank and on the western bank by German defenders still in place.

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[106] MG Walter Krause, *Defense of Metz 1 to 18 September 1944*, 15.

[107] War Department, Field Manual 100-5, *Operations*, 1944, 231.

[108] War Department, Field Manual 5-6, Engineer Field Manual, *Operations of Engineer Field Units* (Washington, DC: Government Printing Office, 1943), 68.

[109] Cole, *The Lorraine Campaign*, 135.

By early the next morning, around 0600, 7th Engineer Combat Battalion reached the river with assault boats. These were available primarily because the Combatant Command B commander, General Thompson, personally procured them from the rear, as it was not a previously coordinated effort.[110] Assault across the river did not begin until 1045. By early afternoon, around 1330 a toehold was captured on eastern bank. Pinned down by heavy fire, requests for combat aviation to suppress Forts Sommy and Blaise were denied. The few infantry battalions in the bridgehead attempted to take the forts were repelled and the bridgehead remained small, consisting solely of infantry. The German 88s were sited to the west bank and impeded any bridge construction.[111] Without surprise, poor coordination and few assets available, the crossing was beyond hasty in nature. Against an entrenched enemy, alert to friendly movements, the crossing should have been deliberate in nature, with extensive planning efforts and assets. Instead, a haphazard movement, during daylight hours, was attempted against a desperate enemy inside a fortress city where even retreat was no longer an option.

While the attack in Dornot floundered, MG Irwin directed his other units to begin probing farther south, in the vicinity of Arnaville in search of a crossing point that would work to cross armor and begin the encirclement of Metz. To his credit, after seeing the complications which occurred in Dornot, MG Irwin had enough patience to allow the 10th Infantry Regiment enough time to prepare for the crossing properly, even though there was a large amount of pressure from above to get across as soon as possible. While

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[110] Cole, *The Lorraine Campaign*, 137.

[111] Ibid., 141.

the fighting was difficult, and there were certainly adverse conditions to deal with, the crossing in the vicinity of Arnaville was about as close to doctrinally correct as possible in an actual combat situation.

First and foremost, the orders for 10th Infantry Regiment, under COL Robert Bell, to begin recon for a new site arrived at 1400 on 8 September, with directions to begin the assault on 10 September at a time and location of the 10th Infantry Regiment's choosing.[112] While not an extraordinary amount of time, the simple fact that there was an expectation of a commander's recon to determine the location and timing of the attack acknowledged the importance of the commander's decision and the planning that a crossing entails. In Dornot, the lead element was directed to identify the crossing site and relay the information back to the headquarters and the engineers after the beginning of the operation.

COL Bell conducted a recon with the assault battalion commanders and officers, viewing the objectives and crossing sites from high ground just west of the eventual crossing site. Provided with better maps, and actual eyes on the objectives prior to execution, the coordination and understanding of the operation enabled a common operating picture. Final assembly areas were identified and timing was discussed, with just past midnight on 10 September being identified as the beginning of the crossing. While the actual crossing did not start until 0115, the key doctrinal point of crossing under the cover of darkness and using surprise for an advantage matched FM 5-6.

[112] Kemp, *Metz 1944*, 104.

Also unlike the Dornot crossing, this one was properly resourced with enablers. Thirteen Field Artillery battalions were directed to support the crossing, taken from XX Corps and Third Army.[113] Further, air support was available. Requests for air support, in the form of dive bombers, at Dornot had been denied on the basis of mission priority. However, the dismal showing for getting across the Moselle River on the 8th clearly identified the need for an increase in priority level. Therefore, air support was redirected from Brest. Finally, the engineer assets were prepositioned and in enough quantities to enable the crossing of not one, but three potential obstacles, located with the lead elements.[114]

Although the armor was unable to cross initially, the tanks and tank destroyers which were to be used in exploitation once the crossing was achieved were placed along the banks to provide overwatch on the crossing site. High hills surrounding Arnaville provided a suitable vantage point to engage targets on the eastern bank and kept the units nearby to the crossing once it was completed. While there were certainly a large amount of field artillery assets assigned to the operation, the nearby forts of Metz still held overwatch on the crossing site and were effectively impervious to artillery fire. The plan to combat this involved the use of smoke obscuration, generated by the 84th Chemical Company. The unit, previously assigned to the Red Ball Express logistical system moving fuel and ammo from Normandy to the front lines, saw its first combat mission

[113] Ibid., 104.

[114] Ibid., 105.

during the Arnaville crossing. Although there was a learning curve on placement of the smoke generators, with shifting winds, the smoke screen was extremely effective.[115] 109]

It is important to remember that although the engineer effort appeared slow, and at times hobbling the effort to mass firepower on the opposite bank, the 1103rd Engineer Combat Group sustained significant losses emplacing the six bridges finally constructed. Six men were killed outright, and 100 were wounded in action.[116] The conditions of the river, swollen and cold, created hazards which further complicated the crossing. As stated in earlier chapters, bridging operations are complicated events, with specific guidance for emplacement. Replacement by infantry, while possible, was not ideal due to the level of specialization in training for each type of bridge. According to FM 5-6, a reserve of up to one third of the engineer effort should be held at the division level, yet there did not appear to be any reserve in this effort.[117] There were three separate types of bridges installed by the end of the operation: two Bailey bridges, three treadway bridges, and a ponton bridge.[118] Given the number of engineer units already committed to crossings throughout the Third Army area of operations, it is likely that the lack of an engineer reserve was less of a planning failure, and more of an operational reality.

These operational realities may have been hard to reconcile for leaders at higher echelons. LTG Patton, the commander of Third Army, has been hailed as a fine example

[115] Ibid., 109.

[116] Ibid.;, 120.

[117] War Department, Field Manual 5-6, *Operations of Engineer Field Units*, 120.

[118] Kemp, *Metz 1944*, 119.

of American generalship. However, even he is not without detractors. There are some who believe that, in the Lorraine campaign at least, LTG Patton was unable to "reconcile his established notion of how battles should be conducted with the type of battle demanded by conditions in Lorraine."[119] Known for his aggressive style of leadership, and famous for the incredibly fast pace of Third Army sweeping across France, LTG Patton was a true adherent of the mobility and firepower possible with an armored force. The tempo of his operations, and the methods he employed, sought to maximize that potential, even though his units were majority mechanized infantry. This type of single-minded drive worked great on the relatively flat and open plains of France. However, when faced with constricted terrain and a determined enemy, the plans failed to adapt to the situation and suffered losses in time, equipment, and most importantly, men.

Doctrine at the end of World War II was sound for the conditions facing the Allied forces. However, despite experience crossing rivers, the conditions Third Army and XX Corps faced at Metz were unlike anything they had experienced prior. While speed and audacity served LTG Patton well initially, once the logistical tail grew long enough to restrict his movement Third Army was challenged by a problem which demanded a firm understanding of doctrine. The World War II doctrinal tenets for river crossings, while not necessarily perfect, were well founded and provided a strong basis of planning. When XX Corps failed to adhere to doctrine, they found resounding failure. As seen at Dornot, attacking in the wrong formation and at the wrong time of day resulted in confusion and unnecessary losses. When taking the time to follow doctrine by conducting

[119] John Rickard, *Patton at Bay, The Lorraine Campaign September to December 1944* (Westport, CT: Praeger, 1999), 1.

adequate reconnaissance, using the correct formations and order of march, and adequately resourcing the crossing, XX Corps found success at Arnaville, albeit far from easy. No contested river crossing ever is.

CHAPTER 6

CONCLUSION

This paper evaluated how well World War II doctrine supported hasty river crossings. After reviewing the history of river crossing and tracing the development of US Army river crossing doctrine, it appears that doctrine did indeed support hasty river crossings, provided it was followed. Initially, doctrine focused on the tactical level, where employment of the bridge units in coordination with supported infantry and armor units enabled hasty river crossings. However, it quickly became apparent that when considering doctrine of a specialized unit, it is important to have doctrine at all levels which affect operations. Further analysis of an actual river crossing at Dornot identified that failures were the result of leaders failing to understand or adhere to doctrine.

How can the trials and tribulations the army of World War II experienced in developing river crossing doctrine assist in setting conditions for future success? The process identified some key areas which have to be addressed, not least of which is the written doctrine itself. Organizational structure must match what doctrine is based on. Training opportunities for a complex operation such as river crossing is costly, but opportunities exist. Materiel, much like organizational structure, must also match the basis of doctrine. Finally, leadership must understand and correctly apply the concepts found within doctrine.

Doctrine 2015, the most recent adjustment to US Army doctrine, completely revamps the way doctrine is presented and developed. The new Army Techniques Publication (ATP) which covers river crossings, ATP 3-90.4 *Combined Arms Mobility*, identifies within its title that this type of operation is not an engineer specific one.[120] While river crossings are complex operations, they are not entirely unique. *Combined Arms Mobility* recognizes that both wet and dry gaps, as well as standard obstacle breaching operations, have many similar planning and execution considerations. This standardization of approach enables more efficient training. Additionally, the new manual recognizes that in most cases the crossing will require special equipment or materiel that is limited or nonexistent in the brigades.[121] Most importantly, the doctrine includes multiple references to inclusion of engineers and consideration of mobility concerns such as rivers, early and often in the planning process.[122] Combined with actually assigning responsibility for each aspect of the operation in accordance with the War Fighting Functions, the new doctrine continues to inform, educate, and enable training of the force in preparation of a major gap crossing.[123] Good doctrine, however, requires properly organized units to execute it.

Organizationally the Army has slightly corrected one of the issues found in World War II, namely the overspecialization of units. Although major crossing equipment is still held at high levels, the new primary unit responsible for major river crossings is the Multi-Role Bridge Company, which contains multiple types of bridging. These engineers

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[120] Department of the Army, Army Techniques Publication 3-90.4, *Combined Arms Mobility* (Washington, DC: Government Publishing Office, 2016), 1-3.

[121] Ibid., 1-16. The brigade is currently the primary tactical unit, as opposed to the division in World War II.

[122] Ibid., 1-4.

[123] Ibid., 2-10.

actually emplace the equipment, unlike bridge companies in World War II, which means that these units have more capability and flexibility. As the engineer branch continues to redefine its role in Army, with the recent creation of the Brigade Engineer Battalion and the focus on the Counter-Improvised Explosive Device fight in Iraq and Afghanistan, it will remain important to consciously balance specialization and flexibility. As a solid mix of the two, the Multi-Role Bridge Companies support the doctrine and organization of today's force.

These organizations, along with the infantry and armor units they support, require opportunities to train together. While there are few major rivers which are available for bridging training of this size, opportunities exist and need to be maximized. As conflict continues to take an international flavor, it is also important to cooperate with our allies in this training. Recent exercises held in South Korea provided unique opportunities to conduct a large scale river crossing operation.[124] Identifying and maximizing these training opportunities should be a priority in the future.

As noted in chapter 4, the basic concept of river crossing has not changed much since the time of Napoleon. Ponton style bridging remains the most field expedient method for a rapid crossing of a large river. However, with technological advancements, incremental changes have occurred. *Combined Arms Mobility* identifies 14 different categories of bridging for dry and wet gaps, providing the commanders on the ground

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[124] Jeremy Reuse, "US, South Korea Soldiers Conduct Large-Scale River Crossing Exercise," 21 April 2016, accessed 17 May 2016, https://www.army.mil/article/166425/US__South_Korea_Soldiers_conduct_large_scale_river_crossing_exercise/. Additionally, the author observed this same exercise being conducted in 2004 during Cadet Troop Leader Training assignment in Korea. While this exercise is not necessarily conducted every year, it does appear to happen on a regular basis.

with multiple options depending on the conditions faced.[125] For rivers, the Improved Ribbon Bridge is the newest iteration of the ponton concept. Built from aluminum and transported by trucks in much the same way that Civil War carriages moved the wooden pontons, the emplacement of these bridges would be conceptually familiar to engineers of almost any era of American force projection. Bailey bridges, used in World War II, still exist in the inventory. Looking forward, development of a bridge which does not take up as much space, along the lines of the air ponton system, would greatly benefit the military. However, if a technological or design breakthrough enabled such a feat, it would require doctrinal updates, and seems far-fetched given the weight support requirements of the modern army.

In the end, history indicates that leadership makes the most difference. As shown in the assault on Metz, leaders making poor decisions can drastically affect the likelihood of success in a river crossing. Currently, the Mission Command Training Program, also known as MCTP, provides training for division level staffs and higher. One of the primary scenarios used to stress the staff is now a divisional river crossing operation. The complexity and rarity of the operation makes it an ideal opportunity to identify shortfalls in communication and planning. By routinely testing this task MCTP creates a much larger quantity of staff members and commanders who have been introduced to, and fought through, the issues related to gap crossing.[126]

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[125] Department of the Army, *Combined Arms Mobility*, 1-5. Figure 1-1 lists the different types of bridge equipment. Some are repeated, based on usage, but are counted here once to highlight the number of disparate options.

[126] Personal observation of the author, observing 3rd Infantry Division training at MCTP on Fort Leavenworth, KS, 28 April 2016.

However good the doctrine is, it can only be useful if it is applied appropriately. Ask around any army school about the usefulness of doctrine and inevitably the same line is heard: doctrine would be great if anyone read it. This misconception of leaders who don't read or understand their own doctrine has become so well promulgated that it transcends language. Russian officers have been allegedly quoted as confounded by American units, because after having read and understood US doctrine within their own paradigm, they claim it is "impossible to plan against Americans because they don't follow their own doctrine."[127] While this is likely an exaggeration, the knowledge level of army officers at all ranks may not be where it needs to be. Complaints of doctrine being difficult to read or understand notwithstanding, the sheer volume and variety of manuals make truly understanding doctrine a daunting task. History, and the Metz campaign in particular, make the point that failure to know and follow doctrine equals failure.

Regardless of the presentation, there are a few lessons the army needs to understand as it continues to refine doctrine to meet new threats. First and foremost, doctrine must exist. It guides training at all levels, provides a common language and assists understanding for staff officers transitioning from the tactical to operational levels. Second, doctrine must be read to be worthwhile. As the collective knowledge of the Army, the hard won lessons of previous soldiers and leaders are contained in doctrine and

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[127] Aaron P. Jackson, *The Roots of Military Doctrine* (Ft. Leavenworth, KS: Combat Studies Institute Press, 2013), iii. The quoted passage comes from the foreword to this work, written by COL Thomas Hanson, the Director of the Combat Studies Institute. The statement is referenced as a fable from the 1980s which is still commonly heard to this date.

the Army need not endure those lessons again unnecessarily. Third, doctrine writers have to account for the audience of the document. Doctrine is meant for more than new recruits. It applies to developing leaders and professional soldiers alike. It may also be the best source of knowledge in a rapidly expanded Army in future large scale conflict, where training is done quickly and planning timelines shortened.

In today's army, engineer officers have a multitude of career opportunities. Construction, geospatial, and combat engineering are just a few of the unit types that an engineer officer can join. Multi-Role Bridge Companies (MRBCs), Prime Power, and US Army Corps of Engineers postings represent specialty units many officers will never be a part of. As the US Army continues to specialize in all its branches, it is more important than ever to ensure that doctrine reflects the basis of institutional knowledge. This enables professional soldiers of other branches the ability to properly prepare for combined arms operations, new commanders the opportunity to learn about specialties under their command, and provides a source for training new officers and enlistees.

As per usual after a war, the army is shrinking in size now that the wars in Iraq and Afghanistan are concluding. In the event another large conflict occurs and the United States is forced to rapidly expand the army again, well thought out and effective doctrine will be necessary to ensure that the army is able to function properly. Today's gap crossing doctrine is well written and comprehensive. However, based off of the experience of the river crossing doctrine in World War II, success only follows so long as commanders and staff officers understand and follow the doctrine. As seen at Metz, the difference between failure and success is recognizing the utility of the doctrine and applying it to the situation at hand. This is also the key to success in future war.

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